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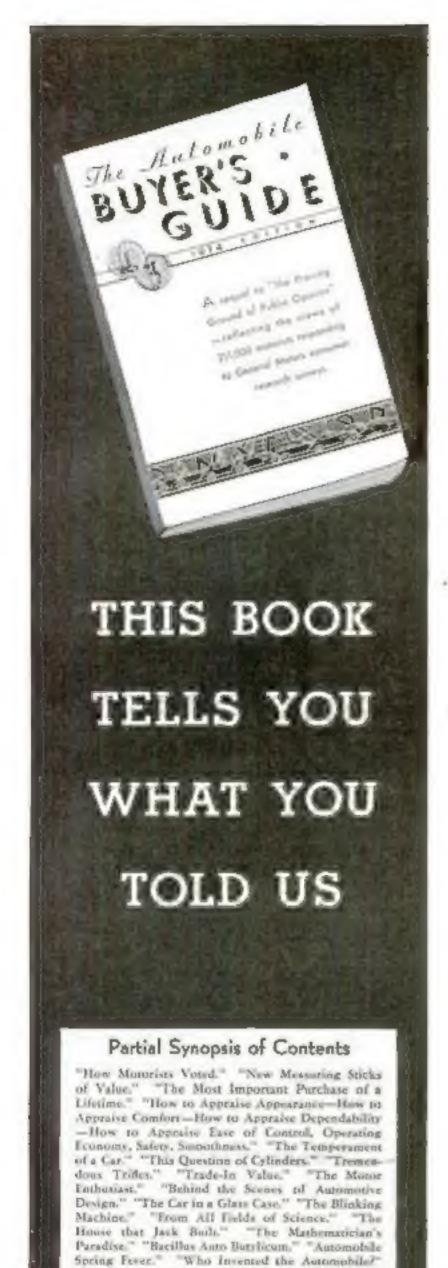


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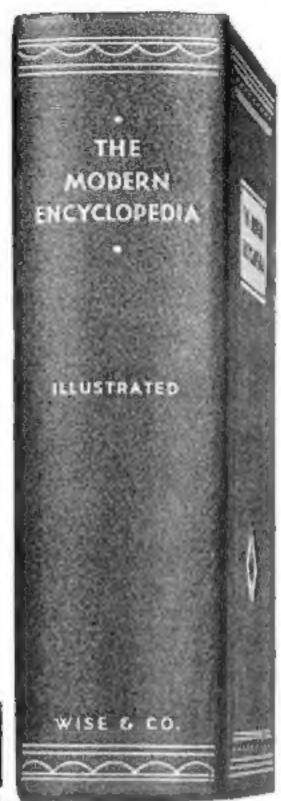
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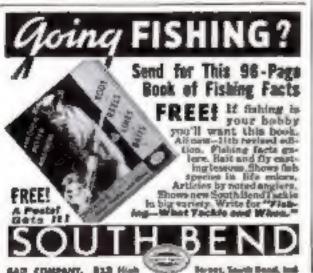


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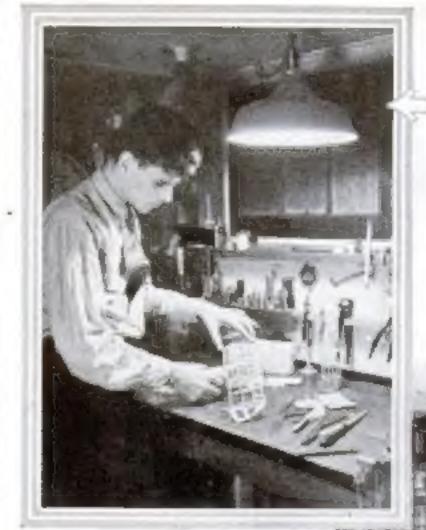
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RIGHT

Historation at left shows the right way to light your shop so no confusing shadows will fall on the work. Below, the light our only throws shall own but also shines in the worker's eyes

WRONG

LIGHTING Your

Home Workshop

DEQUATE lighting is the first requisite of a well-equipped home workshop. Almost more important than the tools and benches is the illumination of the work. Poorly lighted quarters are no better fitted for woodworking or model making than they are for reading.

A bare buth dangling from the ceiling may give a bright light, but its harsh, glaring globe is a menace to the eyes and wasteful as well. To be safe, pleasant, and economical, a shop should be lighted evenly, with corners and shelves as well as benches clearly visible. Main lights fitted with reflectors or globes should be supplemented with portable local lights that can be placed where they will do the most good.

Because no two shops are exactly alike, it is impossible to give any hard and fast rules that will apply in all cases. There are, however, general suggestions that will help you to light your shop efficiently and according to the best practice.

The first step in securing just the right

By R. M. BOLEN

Secretary, Popular Science Institute

amount of illumination is to check the existing light sources. In this portion of the work, you can enlist the free services of your lighting company. Most power and light companies now maintain a crew of lighting engineers, arming them with vest-pocket foot candle meters that give a direct reading of the light available at any point. They will be glad to send one of these representatives to your home to test the illumination. When the measurements have been made, suggestions will be given regarding the illumination required.

Coupled with the intensity of the light are the factors of direction and quality. Lamps used without reflectors, for instance, create a disturbing glare, spreading a great portion of the light over the ceiling instead of directing it down to the

working plane where it is most needed.

A single, well-shielded light source in the center of your (Continued on page 9)

Copyrigited misterial

LIGHTING YOUR HOME WORKSHOP

(Continued from page 8)

workshop ceiling may give ample illumination for movement around the shop, but when machines located near the walls must be used, it will throw dangerous shadows on the work. For this reason local lighting at each individual machine forms an important feature in a welllighted shop. Wherever possible, shadows and glare must be eliminated.

The nize its well as the shape of your shop has a direct bearing on the best method of illumination. Also, the type of work that forms your particular hobby should be a deciding factor in your choice of lights. Ship-model rigging, jig-sawing routing, staining, and finishing—to mention a few types of work—require the best possible illumination if eye strain and fatigue are to be avoided

Convenience of control also is an important consideration when planning the lighting equipment in a shop. Switches and plug-in receptories for portable tools should be placed conveniently. If possible, lights and power tools should be rigged on separate elecuits to insure light even if a short-circuited cord or motor is tilugged into a receptorie and blows a fase. The fuse cabinet also should be conveniently located on the wall where it will be readily accessible in emergences

Other factors entering into the homeworkshop lighting problem are the beight and fin sh of the ceiling, the cleanliness

and come of the walls

With all of these factors in mind, the Popular Science Institute has prepared a booklet entitled, "Lighting Your Home Workshop." It deals more specifically with the problem of illumination than an article of this length possibly could. The booklet discusses in a detailed step-by-step manner ideal workshop layouts from a good righting viewpoint. It will bely you to place switches, locate outlets choose the right type of lamp and reflector and install local lighting that will eliminate shadows.

To assist you even further with your particular problems, a prepared form that will enable you to tell us about the exact conditions existing in your shop is included with every booklet. By filling it out, noting on it any questions you have and returning it to us, you will make it possible for us to endeavor to supply you with the necessary information.

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Our Readers Here's a Red-Hot Argument

About Heat that Isn't Heat

THIS is an answer to M K., Los Angeles. Calif., who appealed to the Einsteins who read POPULAR SCIENCE MONTHLY We think that if he had consulted some good encyclopedia he would have had no trouble with his problems. The question seems to concern the nature of heat and of course everybody

knows that heat is not heat unless it has some material thing to effect. In the first case, if M K, could actually go to the sun be would get pretty hot because his body would conduct heat. Out in space, where there is no matter, there in no heat, because there to nothing to



conduct heat In the second case, the surface of the moon is but because the moon thelf acts as a conductor. On the surth the same those happens as on the moon, with this discretize, that the earth's aumosphere reflects the heat that rises from the ground Since the moon has no atmosphere, its best escapes rapidly causing violent changes in tempera are. Of course, the air itself is a conductor, but the thinner it gets the less heat it will absorb. Therefore, the further you go from the earth, the colder it gets -F E S and C J. C., Littleton, N. H.

If the Whole 5,000,000 Agree, Your Suggestion is Good

I wish to somest that a stamp hage let organized in your magazine an number telling of the new stamps being usued by variour countries You may reject the suggeswith your magazine I think that new in ventions and ideas go with new stamps. In your magazine you have information on boatbuilding, microscopical work, and railroading hobbies. Why not include stamp collecting? It is a science in itself. Watermarks, different kinds of paper, separations, dies, grills, different types of printings are very interesting. The stamps of today show scien-tific progress, geographical locations, types of people, and famous men. Ad in all, stamps contain a great variety of knowledge. I noticed in one of your issues two pages de-youed to the science of stamps. Why not

keep it up as a segular department in each insue? Do you know that it is estimated that over 5.000,000 propie colsect stamps? Thus is more than the population of the combined states of Indiana and Mary-land. Also you should remember that slamp colecting is presembed by



physicians as a means of given the tited business man rest - A P Jr., Sloomfield N J.

Anchored Aurports At Sea Safe Only During a Storm!

I at so with great interest in a recent is sue of your magazine about the floating apports and how they could withstand storms and high seas and he comtorrable in any weather at sex. There is no doubt about the feasibility of anchoring the structure and making it safe and comfortable in time of storm. How are they going to keep the structure from riding the mourings and stepping ento the bight of the anchor cable in cam or light and contrary winds? When that happens, how will it be cleared? When it drifts athwart the moorings, how will it free steel or how can it be towed clear? There are more light shifting minds at sea than there are storm in his From looking over the sketch of the attucture and the anchor gran it seems that the only time that the seadrome will be safe as dueing a heat's Antm. And at such times, of course, while the port would be safe, it would be imposaible for planes to fly and the refuge would be useless.-- J. McC., Leonia, N. J.

Speed of Gravity Waves Is Worrying This Reader

Hank is a problem that I hope some one of your readers can explain for me-We are told that the waves of gravity are the shortest of all waves, but what about their speed? For instance, let's take a com-

mon plank, four inches wide and ten feet long, weighing fifteen pounds. When the plank is lying in a burisontal position, the pull of gravity acts through three and a halt square feet. Non-by flipping the heard. as quickly as we an makine to a verti (a) position gray



ity is picking the same amount through only two or three square inches. Does this mean that waves of gravity are so fast and so short that they can concentrate instantly as to radial area and also be practically constant? In line with the same siea, is there an appreciable difference in weight in a rapsly turning wheet between the down-turning ade and the up turning ade due to the difference between plus and minus gravity accelerations 2-R N. L., Seattle, Wash

Building His Own Library of Perceless Information

I HAVE every isede of your splendid magaone for the past five years indexed and filed I have found the library a vast and very valuable store of knowledge for which I have yet to find a substitute Not only as it valuable from month to month for its individual home workshop projects but also for the clear and concise way at which it shows the rapid strides of science over a

persod of time. I cannot help but wonder as to the great value of this library ten or twelve years from now, especially if it is added to month by month as it must cer-tainly is going to be.-H. L. McD., Vanconver. Can.

Cry from Oklahoma for More and More on Radio

Do you realize that many of its western readers have failed to express our thoughts in Our Readers Say, and yet we wonder why you don't print the kind of articles we want?

We seem to take it for granted that you can read our thoughts, so we just rave to ourselves when we find our invorite article lett out. I want more and more radio! My pal and I spend alt our spare time working on our ra dies, and I know there are thousands



of others that are as interested in radio as we are. The articles you are printing about radio are good but there aren't enough of them. All you ratio tean please write the editor and help me bee him to print more articles on radial Why don't you print an article on one-tube sets? I don't know about the rest, but I know I have more fun footing with one tube sets than I do with four- and ave-tuli ers. But you can rest assured that whatever articles you print on the fascinating subject of ranso with the thoroughly appreciated \$ have enten wondered how you a wass gri the new aleas and inventions a month of two shead of the other mechanical publications. Why not tell us how this is done?- E. T. H., Jr., Watenga, Okla,

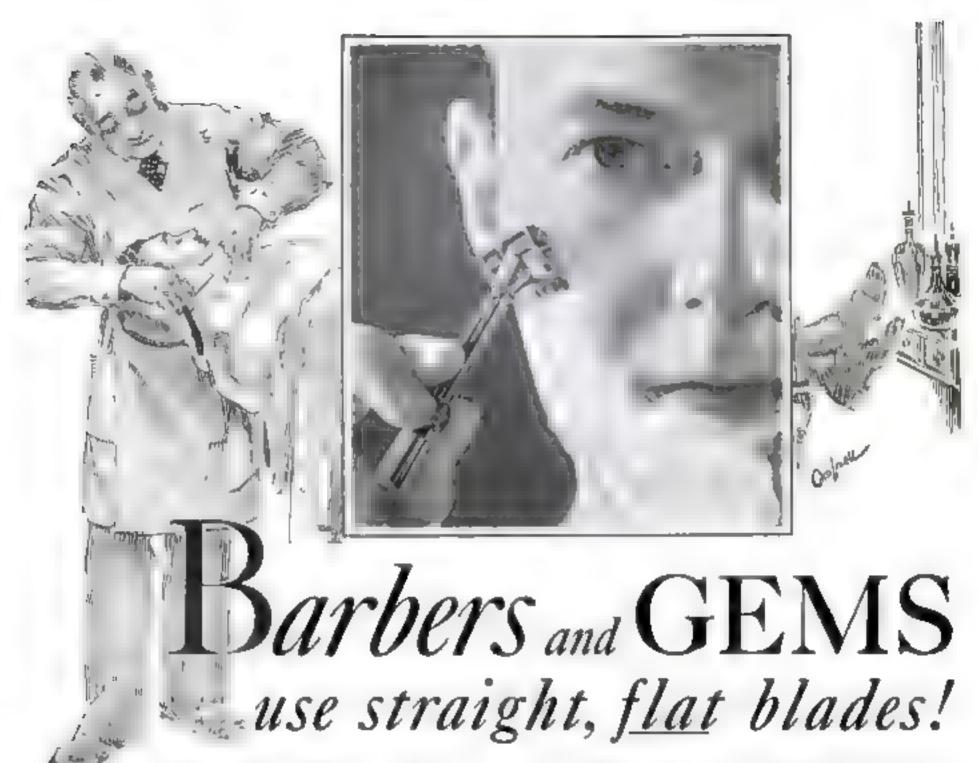
"He" Bees and "She" Bees Are Now Properly Classified

Trees bee stuff, which has recently popped up in Our Readers Say, han't a matter of sex. It's a matter of no sex. C. P. H., of Cannan. Conn., is just as dumb on the problem of sex. in bees as is R P D of San Antonio, Texas. If C. P. H. will do a little totenave studyme he will find that, through some paradox

of nature, the worker bees have no sex, and are neither make nor female, but are termed neuters. The same situacion cuists in the ant family The only "she bee m the hive is the queen and the doesn't work any harder than the "he" bee or drone Het only duty is to propagate the bive. She



has it luckier than the he bee, however, for at the end of the mating season, the dropes



Both work with long, smooth, tugless strokes—both hold the hlade at the same slant—both slide through the beard at right angles—and both leave the face purring with comfort.

Gem's specially designed bevelled top duplicates the barber's stretching fingers, takes up the skin's slack, tightens it like a drum and brings every hair upstanding to be cut at root level.

We build Gem Micromatic Blades of fifty per cent thicker surgical steel—so toughly textured and tempered that they withstand without frazzling the 4840 separate stroppings we

give them. This exclusive process produces a micromatically exact, deeply wedged edge an edge which Dual Alignment (Gem's unique patented feature) holds in such perfect control that it can be used with even greater safety than duller, softer and thinner blades. Dual Alignment locks the blade unbudgingly on the guard at five separate points, and holds it so rigidly that it can't creep, warp or scuff a contour.

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Beautifully boxed sets at your dealer's for a dollar. Or a demonstrator outfit, with a regular dollar razor and a single- and double-

edged blade, to any "doubting Thomas" who'll spend a quarter and send this coupon.

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GEM Razor and Blades

are killed by the workers, while the queen remains an honored member of the household. Let's hope that C P H profits by this lecture. But then, maybe the bees in Connecticut are different from those is lowe. Out here, however, the only female in the hive is the queen, as I supposed everyone knew—E. C. B., Sioux Cary, lows.

Matter in Rotation Offers Some Interesting Tests

Expension matter I find, that once started, it tends to continue in trotation and as the speed increases, the man enoves in an ever larger cycle, and

tends to fly outward. As the speed declines, the rotating mass moves in an ever smaller circle, falls inward and winds up at a central point. We can prove this by simply rotating a smalemery wheel at the soriace of a pail of water with dried beans or sediment



at the bottom of the past to show the action of the rotating Equid. In experiments with the rotation of rigid bodies, we find the metal thrown outward as the speed increases and we conclude that rotation tends to theow mass off at a tangent. But here we find that since gravity boids the object to one spot on the revolving wheel, it cannot move use formly outward as the rate increases, and hence does not give the whole story of rotation. Have any other readers made any experiments on this matter? I could add some of my own conclusions but they would occupy too much space and besides, I am Ancious to get the opinions of others and see if they agree with mine. E. M., Newport, Wash

Steam Power for Planes and Cars Is His Interest

I should very much like to see another article on steam power for airplanes in the near luture. I am anxious to know whether the motor which was developed out to California has been thoroughly tried out as yet I also think an article on "Why We Dou't Have Steam Automobiles" would make very interesting reading. I hope you can give us another article along this line soon.—A. D. F., Holston Valley, Tenn.

He Tells You the Secret of Keeping Up-to-Date

My hexy-noon neighbor just not back from the Chicago Auto Show All he got out of it was the idea that the roads will soon be full of "funny looking" cars. I had read Robert E Martin's article on the new stream-lined stock curs in a revent issue of Populan Scheng Montelly, and was primed to tell him the whys and wherefores. After I got done giving the adentific reasons for the

new lines and curves and the tests which sed to their adoption, he wanted to know how come I knew so much about it I showed him the article. He said "Say I better start getting that magazine!" So aid another customer to your rapidly growing list. Keeping up-to-date is barder



than ever and I don't know any better aid than your magazine.—G. N., Jobet, III

New List of Favorite Acticles We Published

IN ANSWER to R. A. of Cohumbus, O., As to the Readers' opinion of the ten best articles printed in 1933, I give mine: Auto Stealing New \$50,000,000 Racket, (Jan.), Prehistoric Monsters Roar and Hiss for Sound Films, (April), Beer Making is Marvet of Industrial Chemistry, (June); Tricks of Firebugs Exposed By Police Experts, (July), How Strange Disease Accounts For Army of Lost Persons, (Aug.); Mountain Top Roach and Bullet Trains, (Aug.), Rare Stamp Racketeers Thwarted By Black Light (Sept.); Animal Movie Actors Trained By Strange Tricks, (Sept.); Strange Inventions Used By Crooked Gamblers, (Nov.), Cracking of Mighty Glacier Caught For First Time By Sound Camera, (Dec.) I expect there will be many exceptions to this list so let a see them.—C. R., Jr., New York, N. Y.

Mystery of Bouncing Bottle Cleared Up by Photographer

Followers is a brief discussion of the amateur photographer's picture of a bounc ing milk bottle which you reproduced in a recent usue. While such pictures are interest ing in themselves and a ctedit to the person who took them, their accuracy is open to question. The distortation, I believe, is duenot to bending of the bottle but to the manner in which the photograph was taken Cameras working at shutter speeds as fast as 1/1,000th of a second employ focal plane shutters. The shutter consists of a curtain with a slot (or usually a selection of neveral slots of different apertures) which passes in front of the film with variable speed. The rated exposure is the exposure such portion

of the film receives as the slot is passing in front of it. Most focal plane shutters move from top to bottom in the camera. Since the image a severed the image is exposed first and the upper part last. The shadow of the milk bottle, being lower, was recorded first, then the bot



tom edge, and on up to the top From the shape of the bottle in the photograph, its motion can be analyzed as upward, with a capting to the right. The canting motion becomes apparent when one observes that the planes of the top and bottom of the bottle are not parallel, indicating that the bottle was at different of all the beginning and end of the exposure. The composite of their motions produces the result shown, that is, an apparent stretching and bending distortion—D. P. Madison, Wise

Why Does Soap Make This Neil Brush Float?

I just made a discovery When I have a nail brash well soaked its soap and water I notice that it doesn't wok in the wash bowl until all of the soap has gone off into the water I think it was because the soap way porous. Does any reader have a different opinion?—W. L. S., Rome, N. Y.

Thinks Tungsten Rezor Would Last Forever

Some time ago, you published splended articles dealing with facts about shaving and all kinds of raroe brades. About the same time you also published an excellent article regarding vision and gave facts about lenses and the wearing of spectacles. I should like to see these articles revised to include all

that science has discovered since that time, and reprinted in Popular Science Montairs. While on the subject of shaving, I should take to see an article on the various electric razon being introduced to the public at the present time. I have heard that if a razor blade were made from tungsten it would last forever Looks as if some of the manufacturers should develop a blade of this type and offer it to the public, or would it cost too much?—D. N. C., Norfolk, Va.

Oblique Fall of Meteor Explained by This Reader

Recently in your magazine, there was an illustrated article, and a photograph of a car hit by a meteorite which went through the hood and radiator in a later usue I find in Our Readers Say that a gentleman dis-

was hit by the mateorite. He anys, When I read the article I knew that it was not true, or the illustrator was in error as meleorites that strike the earth descend in a vertical direction." Perhaps the above mentioned geniteman was thinking

agrees that the car



of Gameo and the center of gravity test, which is used by our surveyors and is known to the Plumb line. He is right as far as dropping dead weights and objects are oncerned but that theory does not apply where moving objects are concerned. Perhaps I can convince some member of the Meteor Society if he or she should read this. For example, when you throw a grone or even a baseball high into the air the object will not come down in a true vertical line, or, shall I say if you fired a large field or mobile gutt at an angle of sixty-five to eighty-five degrees, you would not expect the shell to stop abruptly at its estimated or given distance and fall straight down It would continue, I say, on its angled course to the earth. The same applies to a bomb tast or released from an airplane. If such be the case, how could you expect a meleorite to tall in a straight hoe at the speed with which it is traveling through the strate sphere? This seems to me conclusive evidence L S New York, N Y

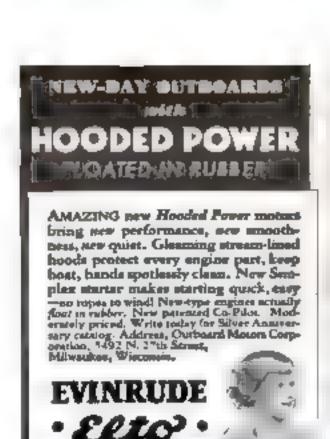
He Knew & Good Thing When He Saw It, But Conscience-

Stace the middle of last August I have been bitch-biting around, like a lot of other kids these days, and working at whatever I could get I do While in Chicago. I you ed the World's hair I was interested it would eshibit and also in a copy of The Poixet Guile to Science. I wanted a copy of that book pretty badly, but I had hitch-hixed from California and had no money and no job. So I just slipped a copy in my pocket and got away with it without paying for it. I've been working on a ranch near here

toe a while and although I am getting only my keep and a little spending money once in a while, I can spare the money now for the book to I are torry I took it and want to squeeze myself as a punishment, I am enclosing a dockrifer it and hope it will be enough While I regret the



manner I came by it, I m still glad I've got



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THE HANDBOOK OF APPLIED MATHEMATICS

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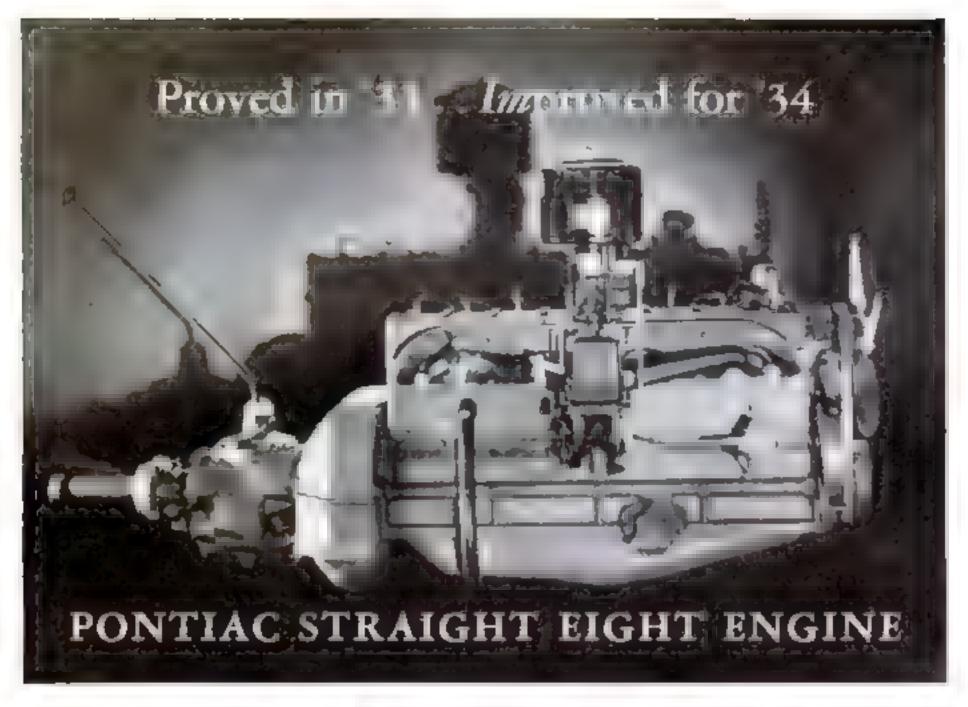
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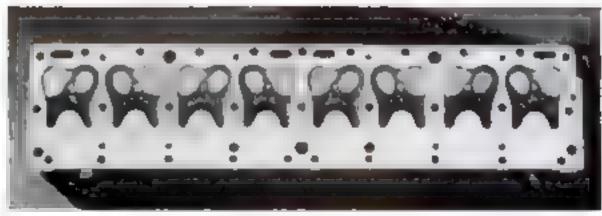
Auto Trains



Develops Greater Power . . . Delivers More Speed . . . Burns Less Gas Per Mile

Last year's Pontise motor was noted for its amouthness... its power, speed and economy. The power plant of the 1934 Pontise, thanks to many engineering zefinements, surpasses even its famous predecessor. Power has been stepped up to 84 h.p. ... speed increased to 82 m.p.h. . . . yet the amazing Pontise togens gives more miles to the gallon by a generous 10 per cent. As to assertionest, a prominent engineer states, "If you want more insectioness than you get in the Pontise Straight Eight engine, you've got to go to a motor of more cylinders."





New High Compression Head, Shown Above, Increases

Engine Efficiency .

The 1934 Postiac engine uses a new and improved type of General Motors Research cylinder head with a compression ratio of 6.2 to 1. Directly above each valve, in the combustion chamber, is a metal boss or button. This cuts down the clearance space above the valves and brings the valve heads closer

to the cooled roof of the combustion chamber. The major advantages of this cylinder head design are: a smoother and less restricted flow of incoming and outgoing gases in the combustion chamber, and also cooler valves. The extra water-cooled surface in the combustion chamber adds enough cooling effect to permit the um of a higher compression ratio (6.2) without necessitating the use of premsum-priced, anti-knock fuels.

At Left-New Vacuumatic Spark Control and Gaselector

Credit for much of Pontiac's new fuel economy goos to its new system of controlling the spark (see device at right of distributor) by a vacuum created by the suction of the engine. This new method uncertagly advances or retards the spark to obtain maximum power from minimum fuel at all speeds and loads. It responds instantly to the ever-varying requirements set up by the throttle, . . . The Gaselector, shown just below the distributor, permits setting the spark to obtain maximum efficiency from whatever grade of fuel is used . . . Pontiac Motor Company, Pontiac, Michigan.

GET A STRAIGHT EIGHT FOR YOUR MONEY!



POPULAR SCIENCE

April 1934

Vol. 124, No. 4

RAYMOND J. BROWN, Editor



New Mystery Rays

TAP POWER HIDDEN IN ATOM



Dr E O Lawrence with the world's biggest electromagnet at the University of Californ a magnet is seed to produce neutron rays, the most penetrating ever creesed Left schematic diagram gives idea of method of producing neutron rays

Prefer By Releasing Protects and Abusto

MAGNETIC merry go-round, firing electrined particles at 50,000 miles a second, bas just generated the world's first neutron ray in a research laboratory at the University of Cal-.fornia.

The new ray represents the culmination of years of study by two California scientists, Dr. E. O. Lawrence and Dr. M. Stanley Lavangston. It is the most penetrating ray ever created in a laboratory, a giant brother of the X-ray and the gamma rays of radium. It has the anomalous property of penetenting heavy substances more easily than light suostances. Thus, hydrogen, lightest of gases, is almost an impassable barrier, while the ray passes throught lead with comparative ease. Its practical possibilities at present remain unguessed. Ten milion neutrons a second stream through a lead window when the rays are being generated. Neutrons are the elect-neally dead particles which British physicists discovered two years ago when they blasted lithium atoms apart in a Cambridge

laboratory. Until that time, it had been thought that atoms, the tinest bits of matter capable of existing alone, were composed solely of positively charged particles, called protons, and negatively charged particles called electrons. The usual concept of the construction of an atom has a group of electrons whicking around a central nucleus composed of a proton or group of protons as planets wheel about a central

Everything in the world-men, machines, plants-are composed of these tiny units just as a wall is built up of bricks. Fifty trillion ordinary atoms can crowd together on the head of a single pin. From such inconceivably small storehouses of power the new ray obtains port of its energy

In their work, the California physicists use the largest

 $\mathcal{B}_{\mathcal{Y}}$ JOHN E. LODGE



Mercy Hospital C. 12 has instanted this 500 Worker X by apparatus 1 has been from the grant pro-

who are standing below it

magnet ever made, a scientitic big Bertha that towers higher than a man's head and weighs mure than thirty-five automobiles. Between the upper and lower halves of this magnet, each looking like an immerue metal. grandstone mounted on a vertical axis, the scientists abde a vacuum chamber having the apprarance of a covered fiving pan. Inside it is the merry-go-round, a confaither shaped like a pillbox and made of brass.

Into this pil.box, the men feed deutons, the central particles of the

recently discovered heavy hydrogen atoms. These are formed almost entirely of a combination of electrically dead neutrons and electrified protons. With the magnetic field holding these particles on a circular course, a 20,000-volt current is applied alternately to opposite sides of the brais container.

These successive kicks, perfectly synchronized, whirf the particles faster and faster until they are spinning at fantastic speeds and have acquired as much energy as if burled by 3,000,000 volts. At this point, they are released from the electric sling and propelled into a silver-whate target of lithium, the lightest of the solid elements. The result is a shower of neutrons issuing both from broken deutons and shartered lithium atoms. Thus, port of the

energy of the penetrating rays is the result of cracking the atom.

This suggests sensitional possibilities. In the long quest for atomic power, through tapping the energy stored in these unvisible components of all matter, the main problem has been to find the right projectile to split apart the atom. The deutons used in California are the beaviest and most etherent bullets so far employed. The energy they return for the amount full in is greated than that obtained by any

1.800 times that of an electron bursts the atomic nuclei apart and sends off shooting particles far heavier than the electrons released by X-rays or gamma rays.

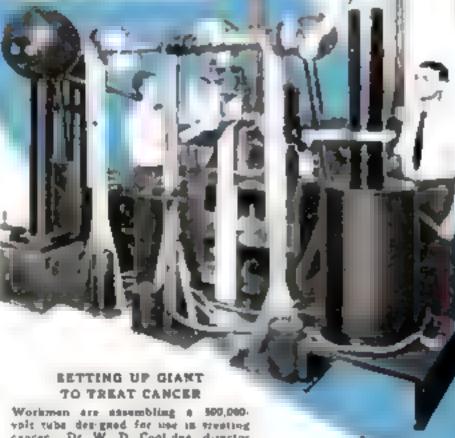
One experiment has shown that the new ray has the power of changing light chemical elements into heavy ones. When aluminum, for instance, was subjected to the neutron bombardment, its atomic weight increased. The neutrons, in this, instead of breaking up the nuclei, had joined with them, thus increasing their weight.

Blocks of parafin, containing a high percentage of bydrogen, are being placed in the path of the rays. When the neutron stream hits them it breaks up the hydrogen atoms, setting free a shower of particles with trails that can be seen and counted in a special chamber. In one test, these trails indicated that 10,000,000 neutrons a second were streaming from the magnet and bombarding the parafin. In fact, it was this display of atomic freworks that first proved to the experimenters that they had created the ray

Because the haman body is twotheres water and its hydrogen cun ent is high the effect of the new ray in treping disease remains to be determined. At all even s, its penetrating power

even through hydrogen, is greater than any tool now at the disposal of the radiologist in the expert is called who uses X-rays and radiant to perform modern feats of scientific magic

At the same time that the new ray is reported from Caufornia word comes from Europe that I'rot F. Johot and his wife.

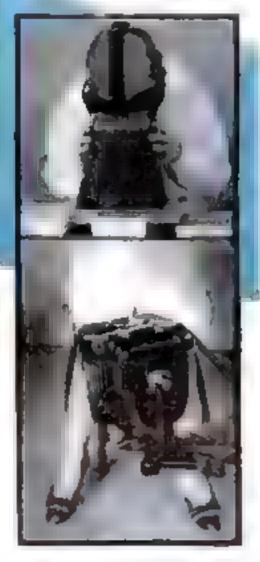


Workmen are assumbling a 500,000volt tube designed for use in treating cancer. Dr. W. D. Cool dga, director al the General Electric Laboratory de vised the system employed in this giant

other method. If the workers can increase the energy obtained from shattering atoms without increasing the energy put into the work of breaking apart the electrons and protons super-powerful and super-efficient rays may be created for remarkable work in the future

At present, the two California scientists are engaged in careful tests, seeking to obtain a clearer picture of the ray they have created and of its possible applications.

Because the neutrons carry no electric charges, they shoot through atoms underlected by the "walls" of electricity which surround the central nuclei. Only when they make a direct bit are they stopped. Then their mass.



INVISIBLE FORCES, RECENTLY DISCOVERED, LEAD

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B to of metal

Irene Curie-Joliot, the daughter of the discoverers of radium, have, for the first time in history, produced artificial radioactivity. By bombarding aluminum, magnesium, and boron with positively charged particles traveling 18,000 miles a second, they caused the targets to give off radiations similar to those of radium.

New developments in X-rays and new uses for radium are constantly widening the field of the radiologist, who now works not only in the hospital and surgeon's office. but at the factory, the foundry, the arsenal, the art gallery, and the police laborstory. His invisible rays are solving mysteries, preventing accidents, diagnosing ills

both human and industria.

One of the most amazing of all feats of X-rays occurred not long ago in an eastern tity. To study the action of an ailing beart, a surgeon made a tiny opening in a vem of a putient's arm and inserted a rubber tube hardly thicker than a hair. He carefully worked it up the year to the neck and down an artery to the heart itself, all the time following its progress by means of X-rays.

With the end of the tube actually inside the vital organ, he injected through it a metallic element which revealed the changthat outline of the heart in all six details and enabled him to make a thorough diagnosis Then, he cautiously pulled the tube back up the artery and down the vein and closed

the opening in the arm!

In other cases, metallic substances that register sharply on an X-ray negative are injected directly into the bloodstream so the action of the veins and arteries can be

studied by the diagnosing doctor At Beth Israel Hospital, in New York City, "X-ray talkies" are now filmed to help doctors study diseases of the heart While the apparatus snaps pictures, making them in 1, 120th of a second, a miniafure microphone Within a stethoscope transforms the sounds produced by the contracting of the heart and the snapsang of the valves into electrical impulses which move a lever in a beam of light and thus create a sound track on the film, perfectly

M Searley I compared left and Dr E O I were a to high ear and a mag to be the a feath of the analysis of the eve A lowe to diagram shows one-turning of magnet

synchronized with the pictures. By a comparison of sound and picture, the expert is able to find the exact point in the beartbeat where an abnormal sound occurs This is of great value in making a diagnosis and laying out a course of treatment

That modern X-ray apparatus literally can find a needle in a baystack was demonstrated, a few months ago, by engineers at the General Electric Laboratory, in behenectady, N. Y. They placed a small

needle at the center of a bale of pressed bay, five eet high. When the X-ray film was developed, it showed the exact foration of the bit of metal.

To the average person, the operation of these miracle machines is still a mystery. How are the rays formed? How do they penetrate solids? How do they make pictures? How do they aid in curing disease?

New machines range from 800,000-volgiants, giving an much radiation as \$75-000,000 worth of radiam, to midget tubes that barely reach across the palm of the hand and function in machines that can be plugged into an ordinary light socket. Most of them operate in the same way. Take, as an example, the new 800,000-volt apparatus installed in the Mercy Hospital in Chicago

It has a battery of four glass vacuum tubes having an overall length of fourteen feet. At one end is a coil of tungaten wire about the size of a postage stamp, This forms the cathode (negative electrode) reaches a heat of from 2,300 to 2,500 degrees and sends off a stream of negatively charged particles which form the cathode rays. At the other end is a round watercooled tungsten turget, positively charged. Magnets steer the cathode rays down the fourteen-foot tunnel of glass to bit this four inch buil s-eye.

As the carbode rays hit the target, they change into X-rays, just as the energy of a bullet turns into heat on stopping suddealy in hitting a steel wall. These X-rays shoot out of the tube in all directions but shields of lead prevent their escape on all sides except the one on which the patient or object being examined is placed.

An expert, simply by looking at a tube in action, can tell you whether it is giving off "batd" or "soft" rays. The soft rays give the greatest (Continued on page 120)



THE RESERVE OF THE PARTY OF THE REVEALED BY THE REAY

At far left, mayor strip of bussen ungamade with mode n. high spred X ray Upper left, automatic p siol is seen by X tay Below It. 40 X ray p cture of a car's stessing wheat showing delects in metal

SCIENTISTS INTO REALM OF UNEXPLORED MARVELS

How Nighthawk Inucks



Steepy Uleich, driver of the truck and trailer known every traffic light between York Pa and Machattan

he highways when darkness fall sing hg over he is and valleys, heading to torget cites. While the yaat ameen cutavan transports bread anflowers, mak and steel, eggs and bugexplosives.

Recently I rode on a 200-mile overright run across Pennsylvania hills and New Jersey highways from York, Pa., to New York City to watch first-hand the operation of a fast modern highway ex-

The trip began at the York terminal "Steepy" Ulrich, the driver, was paint ing the big chains on Truck 35 with oil as I crossed to the end of the long shed

Behind us, a dozen men toiled in the glare of the loading platform. Buxes, but rels, crates, bundles were being packed nto the hage bodies of trucks and trail ers. Tasiboards slammed, Motors barked and roared. Machines lumbered away into the darkness heading north, south, east The night fleet of the York Motor Express was beginning to roll.

Ulrich finished his last-minute Job carefully hung his brush on a hook under the truck, stowed his pail of nil, look ing like black molasses, in a rack on the running board, and we both climbed up into the cab.

Our load was ready. The "tickets" covering the consignments were handed up in an oilcloth pouch. Fifteen tons, in-cluding 10,000 nickel cigars, two dozen guinea pigs, wallpaper piled like cords of stovewood, a crate of yelping collie pups. and an anchor chain for a steamship. were riding on the eighteen balloon tires of our truck and trailer

We were more than a fifth of a block long as we pulled out of the shed, rolled down a dark alley, and turned into the

ghitering main street of York, Sleepy tooked at his watch. It was nine P. M. For six years, he has been pulling big soads out of York. For fifteen, since he was a marine in the World War, he has been handling trucks. Built like a Minnesota fullback, he weighs 220 pounds, has a slow, good-natured grin, and is rated one of the crack trailer men of the East

For five minutes, we worked our way through traffic, along residence streets post silk mills luminous with the blue light of mercury-vapor lamps, out to the suburbs. Then we settled down to the one ernod. The roar and clatter of the big engine filled the cab. We were bitting thirty-five miles an bour, making time on the level road to Wrightsville and the bridge across the Susquehanna

Truck transportation, in the last few years, has grown to major importance In less than a decade, the number of machines traveung American roads has tripled. In 1921, it was under a million. In 1928, it had passed the three million mark. Single companies now have fleets of from 8 000 to 14,000 trucks and more than forty fleets of 1 000 or more machines are in the country. At present, three fifths of all the trocks in the world operate on the streets and highways of the I rated States.

Tickets covering countgrittee

a special T THE MET A TOTAL TO was and one other lanks commons by moment change Lint year for instance more than 100,000,000 quarts

of muk came by truck into New York City. Throughout the country, during the same twelve months, 7,000,000,000

pounds of livestock went by truck from farm to city. Forty-two percent of all shipments of hogs, sheep, catale, and carves now roll to market on rubber tires only fifty-eight percent going by rat in the two years between 1930 and 1932 alone, there was a thirty-five percenjump in this total

Ourside our cab, a cold wind rushed past But we were snur and warm. The heat made can be regulated and in emergeneral can even be raised to melt sieet from the windshield. Above my right shoulder, on the wall of the cab, are six flares, like long Roman candies. Every truck in Pennsylvania is required by law to carry such red lights for use if staded on the highway, Each flare hurns for fifteen minutes

A few years ago, before this law went into effect, Sleepy witnessed not far from Coatesville, the strangest accident he has ever seen. A big truck loaded with cylinders of compressed oxygen had broken down and was stalled by the roadside While the driver worked over the engine, a second truck, coming from the rear, crashed into it. The impact expinder. the comparessed gas, shaltered the truck as though by a brast of dynamite, and lossed the heavy steel cylinders, split open like burst frankfurters, in all directions.



of e-Columbia bridge, we pull up wall has of released air from the brake livery one of the eighteen wheels has town air brake enubling the driver to sumoit in his tracks beepy fishes the thilder toll from his pocket. Off again we all around a furniture van with five restant erns strang across its back, and the how! along for a node and a quarter of

Beyond Coumbia, we begin to the 'out of the valley and it is his all the way. Five Mie Hill Three-Mi. His oorhouse Hill We labor up one side an plange down the other, The heavily loaded than the truck, but is we slow down, jerks back as we up, When the trailer is full and the truck is most empty. Sleepy says, you man

Do you know why truck drivers all wear suspenders?" Sleepy asks. I make a guess but it is the wrong one. "It's to keep their shirt tails in, If you wear a belt on a pitching truck, your shirt tails keep coming out all the time?"

Just west of Lancaster, we meet the "Philly Turnaround." It is a truck with a detachable body. The driver has taken one load to Philadelphia, unbooked it body and all, attached another and is making the return trip, all in less than ten hours. He blinks his lights, down and up I ke a man tipping his bat, and Sleepy answers with two yips of his horn

Each year, the eighty-eight trucks of the York company burn almost 600,000 gallons of gasotine and travel a distance nearly equal to a bundred trips around the world. At the end of every run, mechanics go over the big machines as though they were airplanes of a transport line. One man is responsible for the greasing; another goes over the tires, a third is in charge of the gasoline and oil, a fourth spends all his time testing and fixing brakes. The final checkup is in the hands of the driver He examines the batteries the brakes, the eighteen-gallon radiator the oil and the tires before the start.

Even so, the jim sometimes catches up with him. A few nights before my ride, Sleepy had three flat tires in succession. Then both headlight lamps went bad. And finally the engine stopped and he found dirt in the carburetor! To take care of such emergencies, he carnes a flashlight and a wide variety of spare parts, as well as a valuable assortment of tools of his own, for making special

repairs. For him tinkering with the truck is fun. Sometimes, he even spends his spare time around the shop working on Thirty-Five which has been his truck since it was purchased two years ago.

Almost never, however, does mechanical difficulty delay a load for more than a few hours. As a result, the fast overnight service permits goods to be transported to distant crites between closing time of factories one hight and the opening of business places the next morning. A new kind of long-distance manufacturing has spring up as a result.

By the time we reach Lancaster, the houses are dark. Few people are on the streets. We roar through canyons between high buildings, past a huge red brick factory with twin (Continued on page 118)

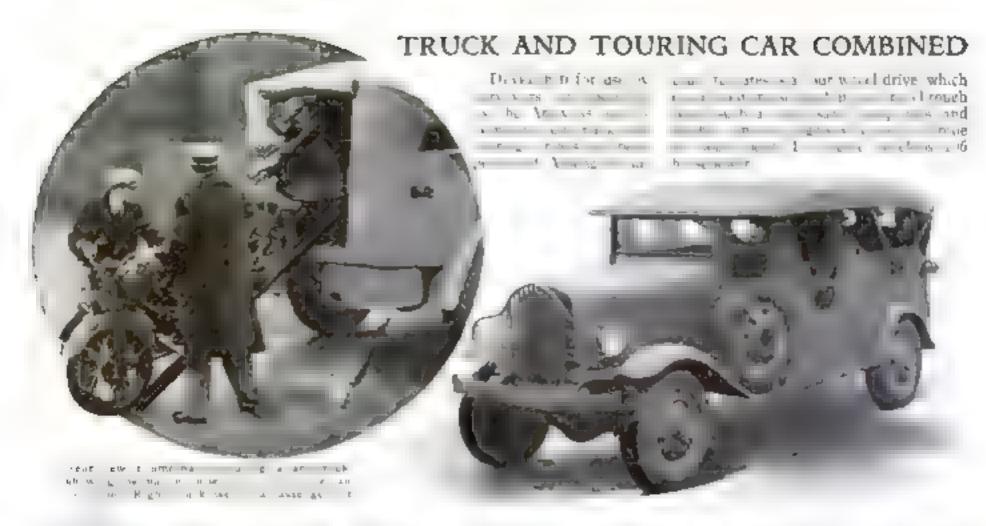
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CHEMIST'S SLIDE RULE SPEEDS CALCULATION

DESTONED for the use of commercial chemists and students of chemistry, a shderule type calculator shows correct formulas and molecular weights for approximately 400 morganic compounds. The device is said to reduce greatly the time ordinarily used in computing molecular weights and solving equations. The holder and the slide are so arranged that the openings on one part conceal or reveal various information on the other part. With the device, it is possible to determine the solubility of a compound in water and acids.



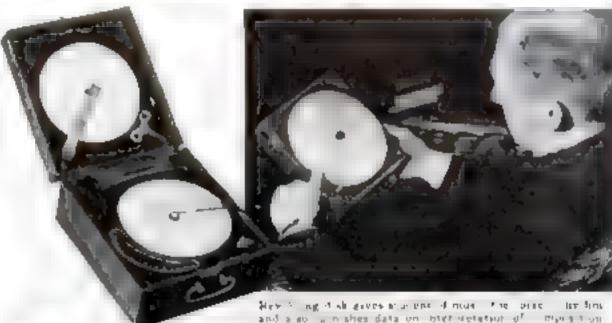
WORD TALLY ON FOUNTAIN PEN

Warters are able to estimate closely the number of words they have written by referring to a scale engraved on the transparent ink barrel of a new fountain pen. Seven sections are marked on the scale indicating the words written from 1,000 to 2,000. The point at which the ink in the barrel touches the scale, indicates the number of words written.

MUSIC TAUGHT WITH WHIRLING DISKS









Engineer adjusting one of the twenty 100,000-wate tubes used as the world's biggest radio station.

GIANT RADIO PLANT MEETS FIRST TESTS

1 sing twenty 100,000-watt tubes, the biggest radio broadcasting plant in the world is now sending out test programs from Cancinnate between one and six o clock in the morning. The statron has a total power of \$00,000 watts, Its grant tubes, water cooled, use a million gallons of water a day In its initial tests. reports indicated that reception was good at points as far away as Aluska, the Canal Zone, and England. It is now believed the station will be audible at any point in the world

UNIVERSAL WRENCH FITS MANY DIFFERENT NUTS

FITTING any nut, from a quarter of an inch to more than two inches in size, a universal wrench of European invention combines in one tool the functions of a large variety of wrenches and phers. When the new wrench has been adjusted, pressure on a hand lever causes the jaws to seize the nut with a vise-like grip.

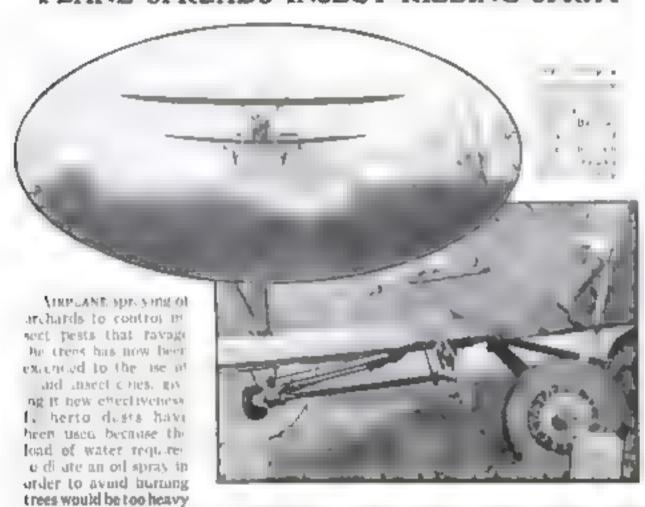
MEASURE STRESS CAUSED BY QUAKES

KNOWN as a stress recorder a device receptly placed in service at Harvard University, will aid engineers in the design of structures that will withstand earthquakes. When msnsature building frames are subjected to artificial earthquakes in the laboratory, the device indicates the stresses to which each member is subjected. and from these fig uses the corresponding atresses that would be induced in a furl-sized huilding can reautly be computed and guarded agaonst.



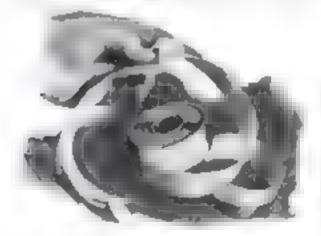
Apparatus used to record earthquake atress on members of mode building

PLANE SPREADS INSECT-KILLING SPRAY



to carry in an airplane. A new air-spraying device, however, dispenses with the use of water by breaking the oil into a must so fine that it will not be injurious to vegetable growth. This is accomplished by feeding the oil into a steel brush that is whirled

nt high speed by the revolutions of its propeller. One such brush is mounted be neath each wing of the plane in the manner shown, and the pilot controls the volume and distribution of the spray by means of valves in his cockpit.



SURGICAL DRESSINGS WOUND ON A SPOOL

Sex ty dressings for minor wounds are supplied in spool form in a first-aid package recently placed on the market. Readily detached for instant use, each dressing combines a strip of adhesive tape and pad of gause, making it unnecessary to lose time in searching for the separate materials. The spool is packed in a dust proof case that may be dropped in tool kit without damage to the contents.



NEW ELECTRIC BULB HAS NO FILAMENT

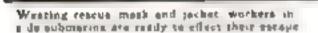
Driving of any filament, an electric lamp demonstrated recently in New York City provides economical light by a new application of the glow of mercury vapor. Two bulbs are used, one within the other and the space between the two is exhausted of air by a vacuum pump. The inner tube contains at either end, the electrodes that cause the lamp to glow. Invented by a German engineer H. J. Spanner, the new light is a development of his "glow lamp" previously described in this magazine. (P. S. M., Apr., '33, p. 40)

ODORLESS ANTISEPTIC

Obortess and tasteless, a new antiseptic compound, whose discovery is reported to the Society of American Bacteriologists, is described as a more effective germicide than foding. The drug, a chloring compound, has a bright yellow color, which persists as long as it is active.

Sub's Rescue Mask Tested on Land







weater breather, while a nosephere closes his nostrile and goggles pro-



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NEW FREE-WING PLANE CAN'T STALL



Wogs on this plane are pivoted to the fundage one-third of their width back from leading edge. Tilting the wing prevents a tall spin

STALLING and tail spans are said to be prevented in a new type of airplane demonstrated the other day at a Los Angeles, Calif., airport. The wings are prvoted to the fuse lage at a point one third of their width from the leading edge, and the pilot may release them in right so that they will tilt to counteract a dangerous span With the coordination between wings and tail surfaces, the craft rights itself automatically and thus prevents a som.



HAND LAMP PROTECTS BLIND PEDESTRIANS

To go and the lives of bland pedestrians at might, a hand signal lamp has been devised by a Belgian inventor. When the user crosses a street after dark, he holds up the pocket lamp and presses the button, lighting a luminous white disk on which three black dots appear. The inventor tirges placing this signal in general use among the band, so that motorists will instantly recognize it

TWENTY-FOOT MODEL REPRODUCES INVOLVED SUBWAY CONSTRUCTION

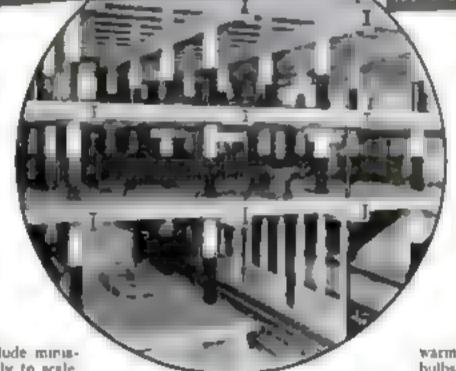


iton individual parts, will include ministure subway trains built exactly to scale, and including the smallest details, and will reproduce the lighting effects.

existing and projected sub-

ways will create a subterranean labyrinth. The completed

model, containing half a mil-



invertor view of model of underground contituation, showing the mass of subway lines

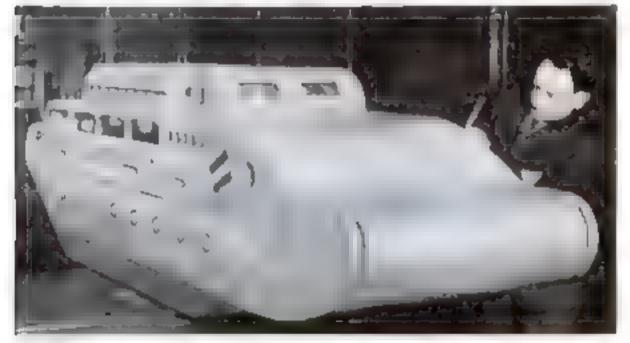
CHICKS RUN THEIR ELECTRIC HEATER

Twenty foot model of labyr nib caused by intersecting subway routes in New York. The model is nearing completion

Bany chicks may keep themselves warm with the aid of an automatic bester recently piaced on the market. Shown below it provides a platform to which the chicks are attracted by a pilot light burning continually at the rear, in center. The weight of several chicks on the platform closes a mercury switch and turns on two heater bulbs at the sides of the pilot. When the chicks get

warm and leave the platform, the heater bulbs go out automatically. That the heater is connected to a wall socket and the chicks do the rest

NEW RIVER BOAT HAS UNUSUAL DESIGN



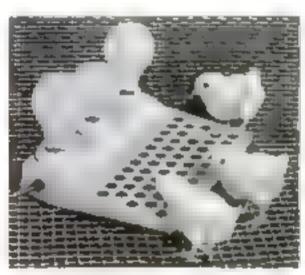
Model of a streamlined boat designed by a flutch engineer. It is intended for one insend waterways and its faventor says it will be capable of unusually high speeds

A butch engineer, C. J Stoel, has embodied his ideas of the streamlined speed-boat of the future in the ambitious model illustrated above. Designed for swift travel on lakes and rivers, its rolling lines afford an interesting comparison with the streamlined ocean liner described on another page of this magname. The inventor is shown applying the finishing touches to his model, which measures more than air feet long, and illustrates

how the craft will present a smoothly curved surface, devoid of projections that would cause wind resistance.

GASOLINE FROM SAWDUST

Swenex has just granted a subsidy of \$50,000 for the erection of an experimental factory for the production of gasoline from peat and sawdust. A Finnish chemist invented the new process.

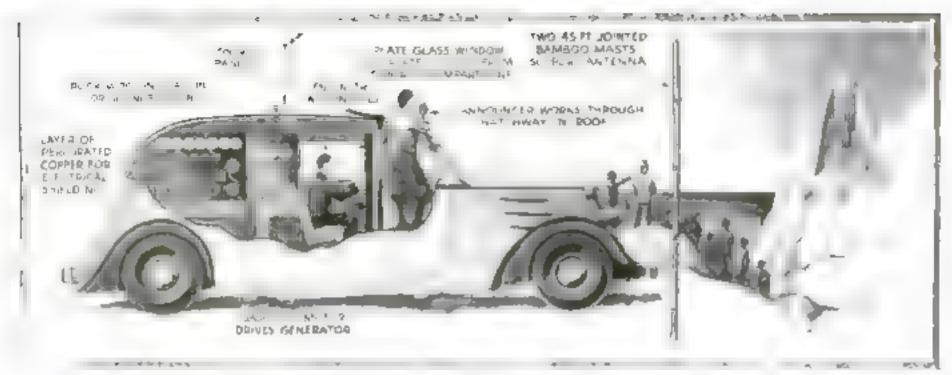


As chicks gather on this platform, their weight moves switch and turns on the heat

OIL-CAN OPENER ALSO A SPOUT

Morog oils may be poured into the crank case of a car directly from their cans through a combination can opener and spout invented by a Los Angeles man. The spout contains a sharp point that cuts a hole in the can. Oil flows out the hole and down the trough provided by the device.





foliatration of radio car showing how it would be used to cover news events by driving right to the spot

Whole Radio Station in Auto

Broadcasting from Scene of News Event Is Now Possible

line to the regular studio, where it is rebroadcast. For ultra-short waves, a high point of reception is required, and the tower of the Empire State Building will be used in the New York City area.

Once the car has reached a destination, a different transmitter, operating on a longer wave length, is placed in service A reel antenna is strong up on jointed masta.

of bamboo. This transmitter has a 100-

When the car cannot be brought to the acene of an event one of the crew goes out on foot, carrying an ultra-short-wave transmitter on his back. This pack transmitter has a five-inite range, and the radio car itself rebroadcasts the program to the pick-up station as previously described

Fixtings of the broadcosting car are amountly compact for their efficiency. The front of the machine is set off as a soundproof studio and is separated from the rear by a thick glass window Standing on the front seat, an announcer may threat his head and shoulders through a trapdoor in the car roof to obtain a bet er view. The two transmit ers. and their contro. panels are housed in the rear of the car, together with a gasoline-driven generator that supplies the power to operate them.

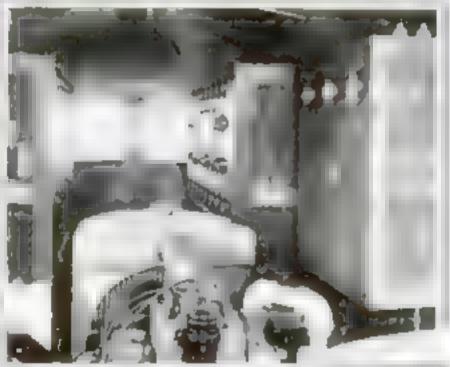


When the car is barred, one of the crew goes in with this transmitter on his back and sends on his te parts by use of altra-short waves

PEEDING after the news at a mue-a-minate pace, a streamined car about to be placed in service by the National Broadcasting Company will represent an innovation in radio technique. It contains a complete broadcasting station that can operate fifty to 100 rotles from the nearest land

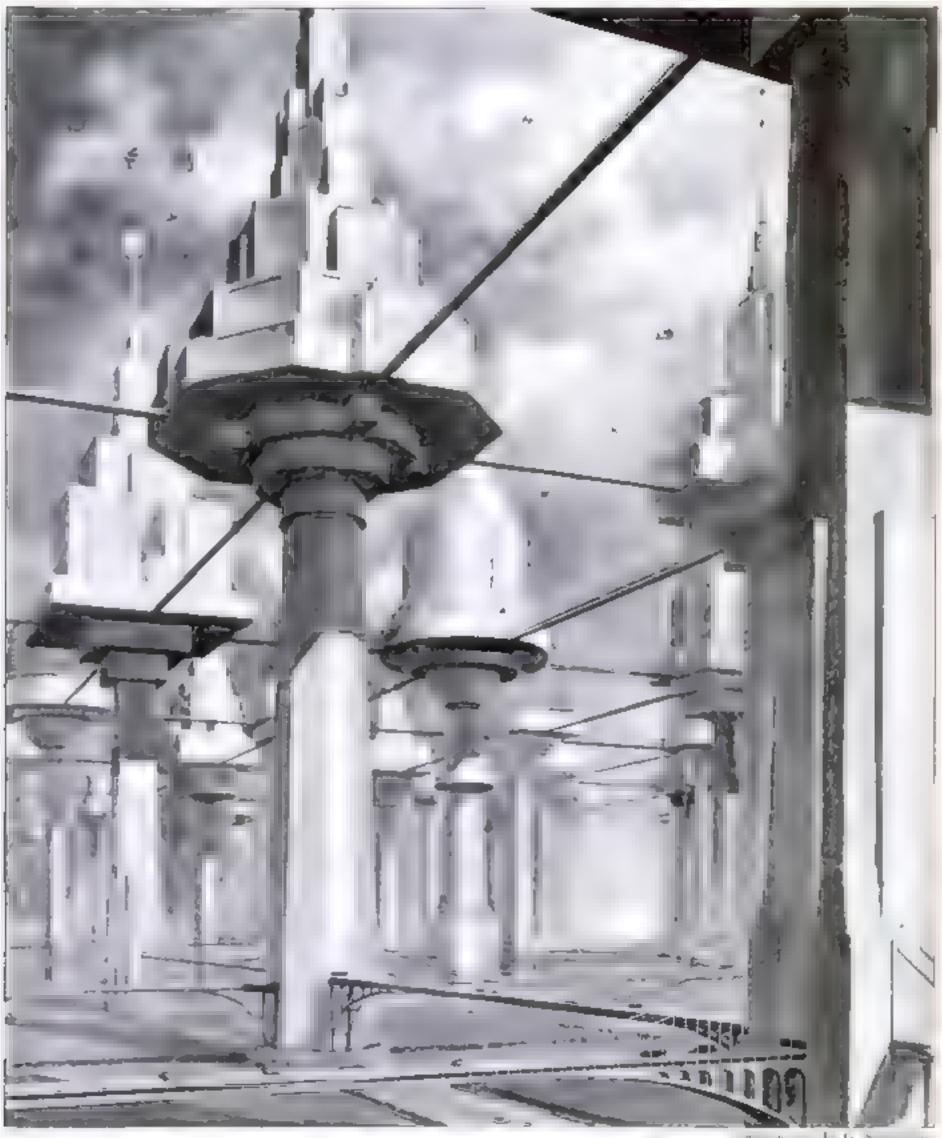
line, bringing special programs of news and sporting events to radio listeners from virtually any point to which the cur can be

Three methods of broadcasting are provided. When the car is in motion, an ultrashort-wave transmitter is employed, using a tiny antenna on the roof of the car. The program is picked up at any convenient point within a lifty-mile radius and carried by land



Above, latered of variable from virging and the land

City of Treelike Buildings Planned



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FASTER, SAFER PLANES DEVELOPED IN

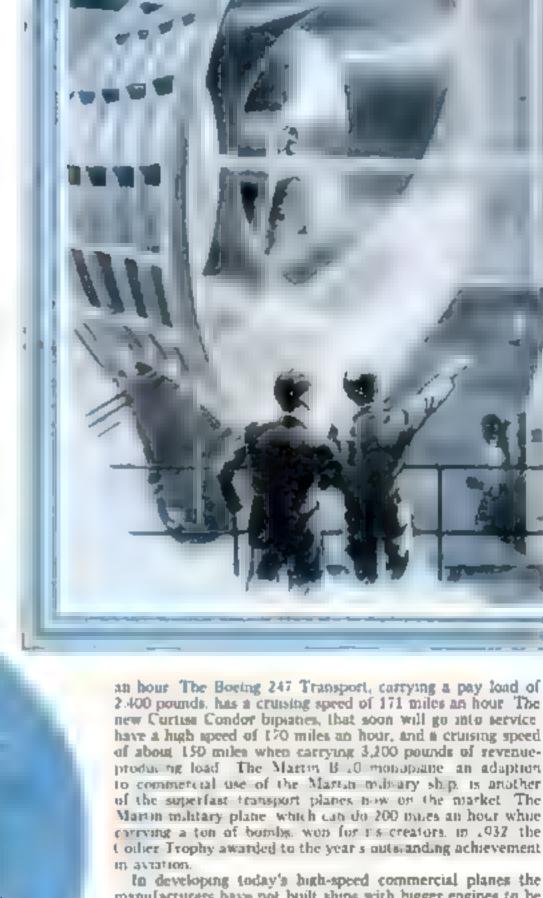
Biggest Wind Tunnel

TPEED with safety in the air Speed with economy of operation. Speed with comfort for air. travelers. For the past few years these speed demands have been insistently made by the users of airplanes and especially by the airline compames whose existence depends on the swift, mie, dependable, and economical transportation of passengers, mail, and express.

The builders of commercial airplanes are meeting this demand so successfully that the operating chief of an important air-transport line tells me that his ships never wear out-that they are replaced by faster planes while they are still in excellent shape

A year ago there wasn't a multi-motored transport plane manufactured that had a rated speed of more than 150 miles an hour

Today the Douglas DC1 Airliner, carrying a pay load of twelve passengers and more than 1,000 pounds of cargo, has a top speed of 240 miles an bour, and an economical cruising speed in excess of 200 miles



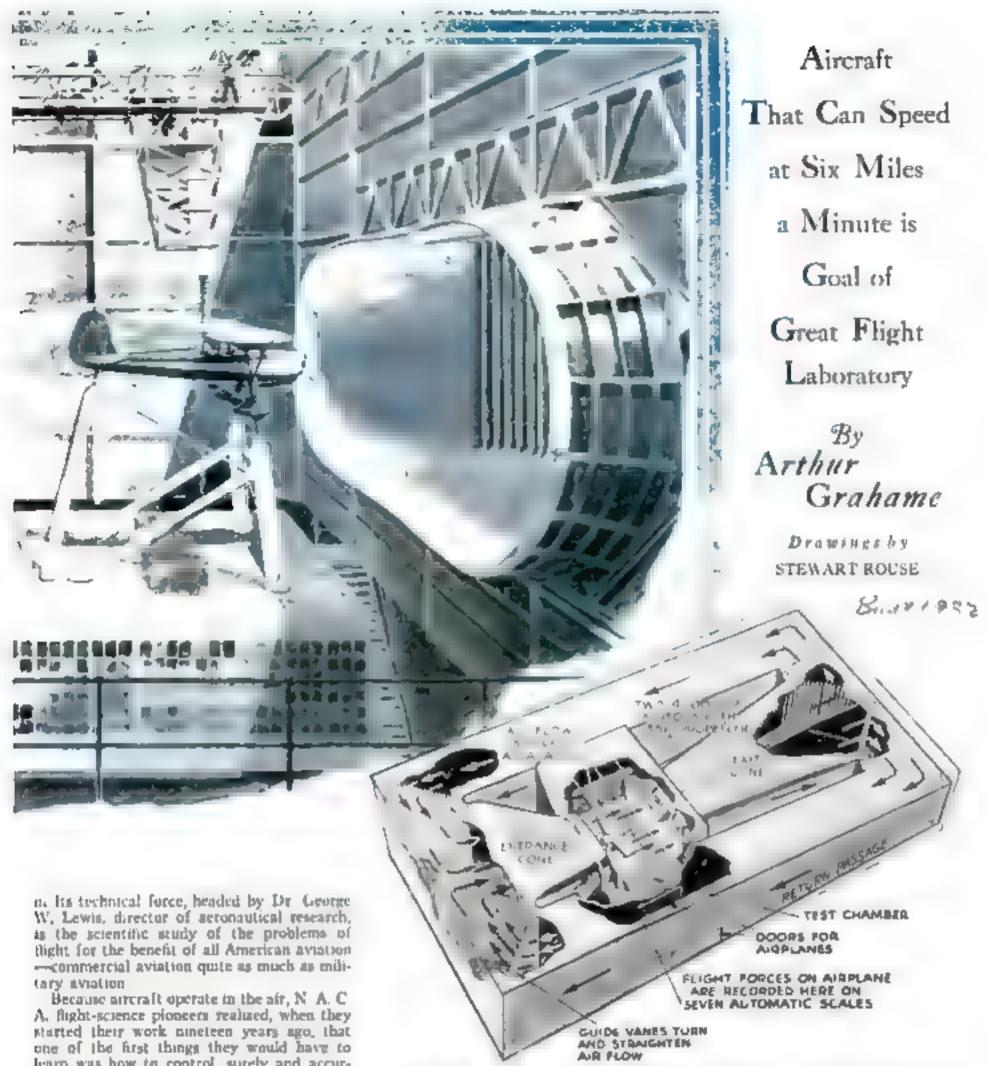
2.400 pounds, has a cruising speed of 171 miles an hour. The new Curtise Condor bipianes, that soon will go into service have a high speed of 170 miles an hour, and a cruising speed of about 150 miles when carrying 3,200 pounds of revenueproducing load. The Martin B 10 monophane an adaption to commercial use of the Martin military ship, is another of the superfast transport planes now on the market. The Marsin military plane, which can do 200 miles an hour while corrying a ton of bombs, won for its creators, in 2032 the t other Trophy awarded to the year's outstanding achievement

to developing today's high-speed commercial planes the manufacturers have not built ships with higger engines to be operated at higher costs. Nor have they sacrificed surworthiness or comfort. They have achieved increased speed by turning out planes of improved design and increased aerodynamic efficiency. In doing that they have followed the trail blased by the air scientists who work patiently for the advancement of aviation in the marvelously equipped Langley Memorial Aeronautical Laboratory of the National Advisory Committee for Aeronautics

The N. A. C. A. has its executive offices in the Navy Building in Washington, and its laboratories, workshops, and hangar on the Army Air Corps post at Langley Field, near Voriolk, Va. It is however an independent government organization. Its fifteen members are appointed by the President of the United States and serve without pay. The job



Cut-away view of room containing instruments that automatically record lift, drag, and force of cross winds as art ficial gave buffets plane. Position of the recording dials is clearly above in the identration



At top of page, the bonie of the world's biggers wind tunnel. A full-size plane is tested in the path of a gale that sweeps out of the tunnel at 1.8 miles on hour and is carried away by the opening at left. Above, cut-away view of tunner showing course of the pir

learn was how to control, surely and accurately for experimental purposes, the most clusive of the elements

Of course, much could be fearned from actual flight. Ingenious and highly accurate

instruments were developed to measure and record speeds, pressures, and the positions of control surfaces while an airplane is flying. But flight tests could not solve all the problems of aviation, So a five-foot wind tunnel was built at Langley Field, In it small-scale airplane models, or full-size small parts of planes, could be mounted on delicate scales and balances, subjected to a blast of air that simulated the conditions of actual flight, and pressures and strains measured

Later on, other and much-improved wind tunnels were built There are a dozen of them now A vertical tunnel is used to study the symming characteristics of small-scale models of vamous types of planes. There is a steel-tank-enclosed, variabledensity tunnel in which models are tested in air that is com-

pressed in inverse proportion to the model's scale. For example, a one-twentieth-sue model is tested under twenty times normal air pressure. Means for studying and preventing the formation of ice on airplanes are studied in a refragerated tunnel. A twenty-foot tunnel, with an air speed of 110 miles per hour, is used for the full-scale testing of propellers, and also of the other parts of the plane, including fuselage, engine, landing gear, and tail surfaces.

Newest, and most impressive, is the full-scale tunnel, the world's largest, in which may be studied and measured accurately the flying characteristics of a complete full-size airplane, and in which engine and cowling problems may be investigated under conditions similar to those of actual flight

At first glance the beg structure that houses this gigantic

apparatus looks as if it was built inside out, for the structural steel frame is outside the cement-asbestos sheets that form
its walls. Of course, there has been no
mistake. This building, 434 feet long and
222 feet wide, was designed to withstand
wind brasts of hurricane force rushing
through the inside of it

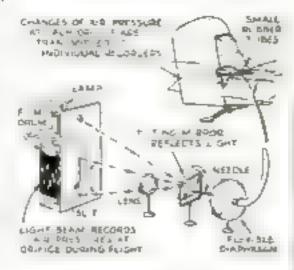
Standing in the lofty test chamber of this house of the winds. I saw, far above my head, the mouth of a smoothly planked elliptic cone sixty feet wide and thirty feet high. Directly opposite it, and fifty-aix feet away, is a similar cone, split by a smooth fairing into two circular passages. In each of these passages is mounted a four-blade, cast-aluminum-alloy propelies thirty-five feet, five inches in diameter driven by a 4,000-horsepower electric motor.

Beyond the propellers the circular pasages gradually change their shape and grow larger, until at the end of the building they are forty-ax feet square. At their ends series of wind values, that look like airplane wings set on end, are adjusted carefully to turn the airstreams smoothly into the fifty-foot-wide return passages that run the length of the building. At the other end more values turn the airstreams again, so that they join in the 110 by 72-foot entrance cone that parrows gradually to sixty by thirty feet at its mouth.

In the big test chamber, between and beneath the gaping mouths of the wind cones, stands a glassed-in control from its roof about level with the lower lips of the cones, Struts, protected by stream aned fairings attached to the roof, protrude from the roof of the control room. On them is placed a plane ready for testing in the settificial barricane.

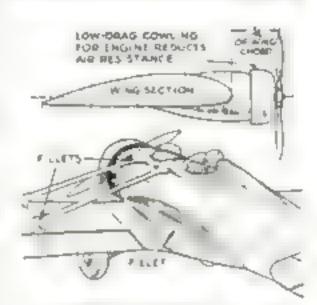
Inside the control room, protected from wind currents, is the basance that measures the six forces to which the plane under test was subjected—a balance large chough to weigh a big airplane, and yet delicate enough to serve as a postal scale.

The strute on which the axles of the plane were mounted, and the triangular



Measuring Air Pressure in Flight

Diagram above how an automatic record a made of changing a ripressure at valous points on enterior of a plane during a dight. More riny orthogony in rudder that admit air which affects female diaphragin



How speed of modern a scraft has been in creased by cowling fillers and proper poing of proper set with regard to he wing a made clear in this diagram. Due of fillers has raised appeal twenty in les an bour

frame to which its tail was attached, are secured, maide the control room, to a turntable attached to a floating frame resting on struts that transmit the lift forces to four scales. A linkage attached to the float mg frame, and acting against a counterweight, transmit the drag forces to another scale. Two other unkages, attached to the frame at its front and back, and also working against counterweights, transmit the cross-wind forces to two other scales. The turntable adows the amplane to be yawed from twenty degrees left to (wenty degrees right, and the frame on which the plane's tail rests can be raised or lowered, altering the wings' angle to the airstream

With everything ready for a test, the flight scientist in charge pushed a controller handle. The big propellers began to pure. A brisk breeze leaped across the test chamber. He pushed the handle over another notch, The wind began to how! and suon reached full gale force. The dials of the seven scales were registering its pressure on the plane. The operator pushed a button, and the reading of each scale was recorded. He pushed the controller handle over another notch, and then another and another, until a mighty blast was roaring across the test chamber at the hurricane speed of 116 miles an hour

Inside the control room the air forces acting on the stationary plane from three corections, much so they would in highspeed flight, were being registered by the dials of the scales, which also recorded the intensity of the rolling, pitching, and vawing tendencies about the plane's three axes. Outside stationed in a car mounted on a movable bridge above the path of the man made hurricane, another engineer was intent on measuring, with a delicate untrument asspended from the car, the ar flow around the plane. Much of value has been learned through this method of studying the downwash behind the wings and the air flow around the tail surfaces of planes

Not all of the (Continued on page 110)

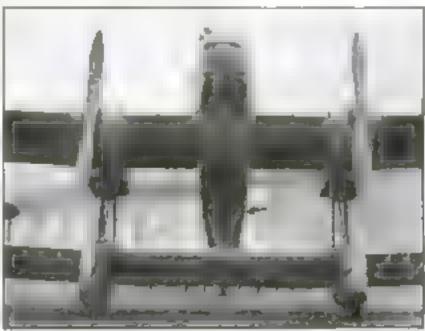
New War Plane Has Movable Gun Turret



Close-up of retractable machine-gue theret on new place

Officially known in an express bomber, England's latest 150-mile-an-hour war plane has been makenamer the fiving ash can 11 takes its name from the cylindrical turret

that can be dropped below the fuselage during flight. Protected within the turret, a machine gunner can pour a deadly stream of fire upon bostile aircraft Mtacking from the reat When no longer needed the turret us pulled back into the fuselage to reduce wind resustance. The big bomber is powered with two 525borsepower motors, and bas a cruising range of nearly 1,000 miles without refueling. Despite Its ponderous appearance, it can rise to an altitude of nearly two miles above the earth, affording an important advantage in wartime maneuvering



Front view of new plane. Dotted line above location of gun torret

Camera Makes Lifelike Statue

454 Pictures Strung Together LIRA SPEED CALERA SE S 454 PICTURES OF LIGHT III New Sculpture Process 1 A streak of light thrown on IN FEAT RES OF the parter out SEREAK OF L GHT inch b a features OUTLINES PROL do camera can re-SUK card been fur reconstruction A S. IT TO PRODUCE N SUBJECT A [65-4 4 1 15 1 " 2 Here is the The sawed-out metal atrips are as sembord on a wore ring and cracks by comura Bach falled with meited paraffin e na emprenentaa tree a profile

a high-speed motion picture camera, set at a thirty-degree angle from the projector makes a continuous record of the glowing outline of the sitter's profile during one complete revolution. An especially ground lens corrects the foreshortening of the contour from this olarque point of vantage, and gives it the same effect as a photograph made at right angles. The result is a one-yard sterp of fum bearing pictures of 454 separate light traces, from which the subject's features can be reconstruc ec

To do this, the picture strip

is first enlarged to the desired size, a photographic chlargement a foot and a half wice and twenty feet long is used for a life sized burt. The print is pasted on a thin metal sheet. stor ceft has k guide a benearli ing sow careful a citting out the out me of each prome. At the end of this tisk the openfor has a pine of 454 curiously sh ped metal plates, each one tepresenting the sitter's profile from a certain angle. When the il tes are now assembled in har proper order on a wire ting the first crude likeness of the subject appears. Paraffin is then poured over the model to fill in the spaces between the plates and to smooth off the surface. So far no artistic alkliny has been required, although a good likeness of the subject has been obtgined. As

a last step, the figure is rea plaster or gypsum mold of the figure is taken, and from this bronze copies may be made. The finished work is said to be as good as that done by an artist

5 The resulting model then goes to a study where it is re-southed by a shi led artist, just as a photograph is retailebed. This operation is a lastrated in the picture area below

ISIT-ING the sculptor ple as going to the photographer and nearly as inexpensive, with the invention of a process known as "sculptography," Already in tue in Japan and

sean from 6

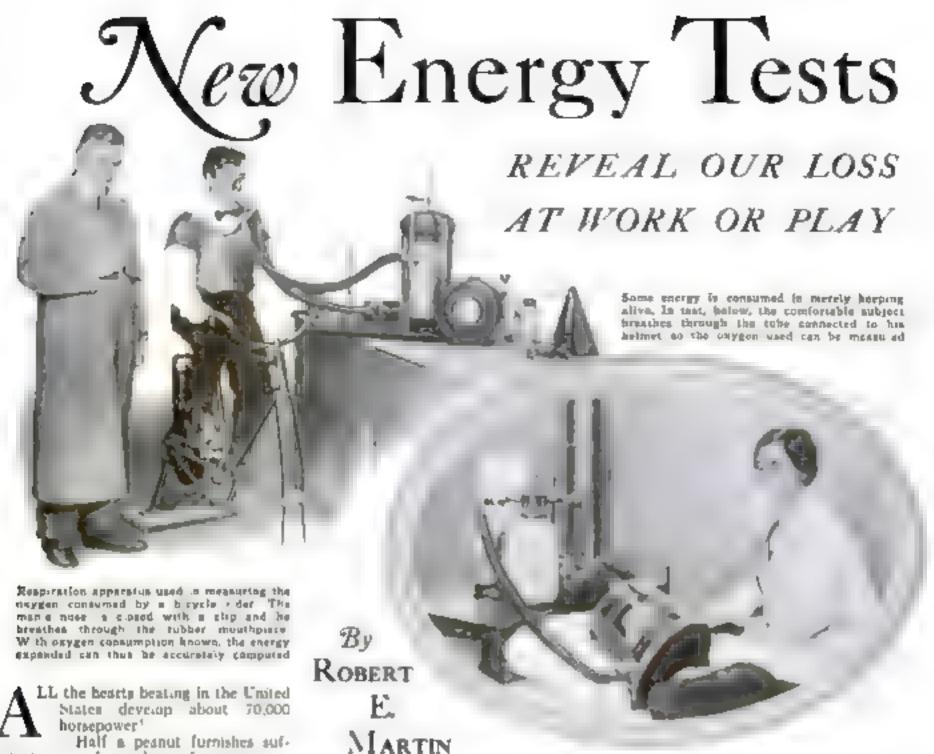
different angle

Enlarged sod pasted to a this metal strip, the film is then cut apart with a jig arw

soon to be introduced in this country, it produces a hust or statuette of startling reabsm by almost purely mechanical means. All the sitter need do it pose for exactly four seconds while a camera analyses his features-and then call for the finished sculpture. When the subject comes to the studio, he is seated in a chair on a turntable and a projector is adjusted so that it easts a narrow, vertical streak of light across his features. The turatable is then set revolving, and

6 Bust of Col bergh made by the new process. It is striking evidence of the fide ity to life in this sculpture





Half a peanut furnishes sufficient energy for an hour of intense mental effort!

Eighteen holes of golf consume as much energy as climbing five times to the top of the Empire State Building, the world's highest skyscraper!

Such are the surprising facts ducovered by experts in the field of experimental physiology. In their study of energy and fatigue they are collecting currous information about our bodies. about how hard we work for a living about the relationship that must exist between energy and disease

Using improved methods and newly devised apparatus, scientists under the direction of Dr. Francis G. Bened et have just completed the latest energy tests at the Carnegia Institution of Washington D. C. Men peddling bacycles without wheels, girls typing at top speed in enclosed cases, subjects living for days in glass houses, helped them assemble data on the energy we use to keep alive and to perform the various tasks of everyday life that constantly drain our energy

When we wake up in the morning, they found, if we he quietly in bed our bodies actually consume less energy than a seventy-watt electric Light bulb! But if you sit up, the consumption jumps five percent Stand up and it jumps ten percent. Walk briskly across the room and it leaps 200 percent. Run as fast as you can and it aooms 1,000 percent. When you lie quiet two lumps of sugar will run your body machine an hour, a pot of butter an hour and a ball, a doughnut will furnish fuel for three hours.

The average laborer, other tests show, has to work eight hours a day every day in the year to turn out the equivalent of 242 Infowatt hours of electrical energy That is just enough to keep the Lindbeigh Beacon at Chicago burning for approximately half a day. In other words, it would require the energy of \$43 men working eight hours a day to keep burning this biggest aerial searchlight in

One currous discovery made by Dr. Benedict was in connection with mental effort. His experiments showed that a housekeeper dusting out the study of an Einstein or an Edison would consume more energy in three minutes than the profound thinker would use in an hour of concentration'

Then why does brain work make us tired?

bix men and two women took part in the experiments which sought the answer Each underwent tests while in three different mental states, awake but thinking of nothing in particular, following a defirate train of thought and concentrating area is Mental effort it was abown slightly increases the pulse rate, the depth of breathing, and the oxygen consumption of the body

But the added energy used is so slight that a piece of banana no larger than the

end of your little finger will support steady concentration for nearly an hour-In fact, the increased consumption of energy is so trilling it fails to explain the mystery of the boddy exhaustion which follows prolonged brain work. The only answer science can make at present is that the strain of the eye muscles in reading. the ear muscles in hearing, and the body muscles in maintaining the same position produce the fairgue,

Every year, the average pair of lungs expand and contract ten mulion times, the average eye roves back and forth thirtysix million times, the average heart beats forty million times, pumping enough duid through our veins to fill fifty averuge railroad tank cars. All this activity goes on without conscious effort. The energy expended in keeping the human engine running while it is thus out of gear is known as its basal metabousm. Metabolism means the process by which our bodies turn food into energy and

After the experts have determined the level of energy consumption required to keep the body alive, they can easily measure the added energy consumed in a given task. There are three ways of doing this One is by the amount of oxygen taken in, another by the amount of carbon-dioxide given off, and a third by the amount of heat liberated by the body

All three occur in such a constant ratio

ond a step one" betw gaged easi During Benedict a tight, best

ond a step. By saying "one hundred and one" between each step, the pace can be gaged easily.

During one of their experiments, Dr. Benedict and his co-workers built an airnight, heat-tight chamber in which a per-

son could live for days under controlled conditions. Ingenious devices enabled the observers outside the glass house to measure the heat produced by the subject when he was asleep, resting quietly, physically active, eating, fasting and concentrating on mathematical problems. One discovery was that a heavy meal will increase the heat output of the body as much as forty percent and cause it to remain above normal for as long as twelve hours

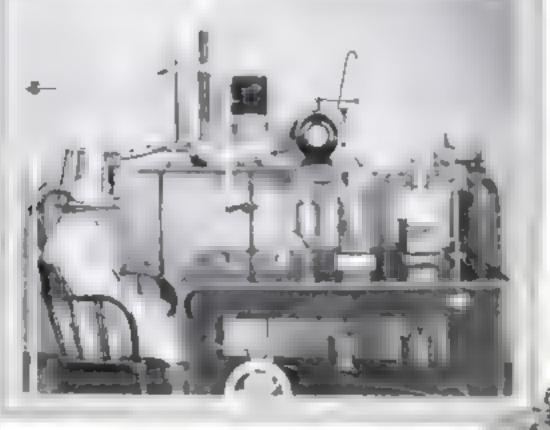
Because the body burns food

English scientist, Dr. A, V. Hill, who was awarded the Nobel Prize for his researches, is one of the most potent chemicals known. It represents a concentrated form of energy nearly four times as powerful as dynamite! One gram, three and a half hundredths of an ounce, contains enough potential energy to hit a ton of rock six feet into the air!

When you turn a page of this magazine, glycogen enables you to do it. Each of the hundreds of thousands of fibers in your biceps is charged with this animal starch. When the command races down from the brain along the nerve lines, each cell of which passes on the message in less than a hundred thousand h of a second, an instantaneous chemical reaction takes place. The glycogen, as though it were gunpowder touched off by a fuse, changes and becomes lactic acid, the chemical found in sour milk. This acid

causes the musce flers to contract to an sonhus bit og your

Immediately afterwards, oxygen, carried along the thers by hood capit aries, reconverts as much as three fourths if he fact c so the a glyingen pro-



CHORES GIRL According to the congen connumps on test, then dam ar works harder at her sub then a datch-digger, or a housewife

HARDWORKING

that any one check will give the in ormation sought. Us us by the oxygen consumption or carbon-dioxide production is used, the subject breathing through special tubes which lead from and

back into rubber bags Using such methods, Dr

Carl Tigerstedt, of the University
Helsingfore, Finland, not long ago covered some surprising things about the
energy consumed in dancing. The Charleston, popular a few years ago, used up,
approximately as much energy as sawing
wood. The Poush Mazurka consumer
almost as much as wrestling. Even the
waits results in a person of normal weight
expending bodily heat sufficient to raise
the temperature of five pints of water
from the freezing to the boding point

On the list of energy-consuming tasks around the bouse, he found washing heads the list. Sweeping comes second with ironing about half as hard as washing. Dressing the baby proved to be seven times as tiring as sewing by hand, and the general work done by the average housewife was shown to be as hard as that done by a carpenter or housepainter

Climbing stairs is just fifteen times as difficult as walking on a level floor. Incidentally, the most efficient way to climb stairs, the way that puts the least strain on the body is at the rate of about a seccolorie it represents the amount of berequired to raise the temperature of also a pound of water four degrees Fahrenber Foods are also measured in calories to anate their energy producing value

If we be in bed all day 1,700 calones of food will keep our bodily machinery functioning. If we work at a desk we need 7,500 calones. If we pitch hay on a tarm we need 3,500. A Maine lumberman may consume 7,000 calories, a six-day bicyclist 10,000. The average man eats more than five pounds of food a day, about a ton a year. Thus, in less than a mooth, a 150-pound man eats his own weight in food.

Astonishing chemical engines within the body carry on the work of transforming this food-fuel into energy. Every muscle is a powerbouse in miniature. It takes sugar brought by the blood and changes it into glycogen, a white, starch-like powder, which it stores up for future use. Glycogen, according to the famous



With but mottrile tightly closed, this girl is breathing unygen through the tubes while trooling, which in fairly easy work

burns up the rest by oxidation. In this way, the muscles are prepared for the next contraction. It has been found that five gallons of blood are required to carry one gallon of oxygen.

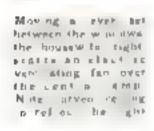
Dr. A. V. Hill has found that for every gram of lactic acid developed during exercise. 370 calories of heat are produced When the (Continued on page 116)

· First Fully Electrified

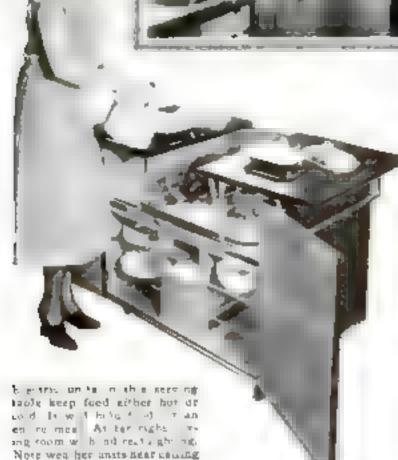


Approach ng rhe e ar e he he sew ear a a he he ard and ne a cor opens he re her so sho he go fen he her e who he he had a util he are at a morsow he me ar a morsow he me ar a morsow











ALLED the star is made compactely plantrue has ang a kitang bugs of me prince I have the a replace problem of the arms of the the game have a serious large a least g the the course of the sealing of the right sex notices. The expects and web your in a promise profit that he are types as it whose are property so here sprongly pressing the mark state of the and the state of the and and a state of the stat Popular cars ses with free chair critery or me A past of the class An or in high brings martitle that the when there is a some go and the bottom of the correct of the property a the right emperate broughout the tar 1 in was to be her hear a major by the fire for the and the same and a time when to happen a spending to the first transfer of elected with a partie of the property of the affects Drive we are there as we were topology up to be prera a make here about the boundary har he but ger in a pin account of his be a very recharges red from distance Awarter to leave the base set wirers be house it will be and more than some minimum to the form with the sehis pisoun healing id in consisting of microscopics on a felicin the walk. An electric sensite in the the cap garage galares, he owner it ma conduct and engle of amount he a rate of remaining to he work course has given on a by become a grant or a transfer of a constraint of the second got bing mark the angle of the angle of the control the second of the second secon THE PARTY OF TAXABLE PARTY AND A RECEIVED and the entering of the parties



House Runs Itself



The serving pantry to provided with electrical apparatus which each so the housewife to propers a light support without uping the equipment in the bitches.



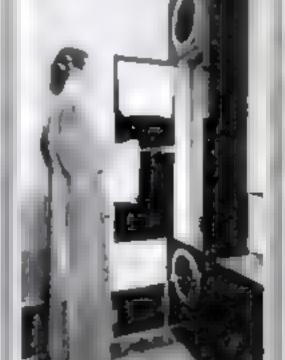
Dirty dishes are placed in this electric washer and the lide-need. Threwing a switch washes and drives dishes



Three tabs we have strained as a second of the second of t

Bew majetoness





In the tokin bathroom is a towel dryer. At the bostom of the dryer is an electric brater and a fan that blows but air past the towels. In the laundty is the big drying plant as seen at left. Most air automatically turns on heater

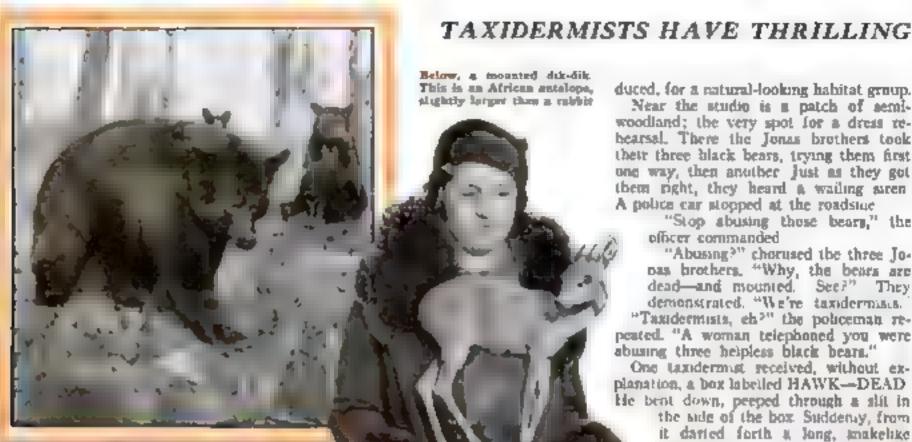


Paration hand a or are provided in the size of the formal state of the state of the



In the basement of the electrified house is the weather-making apparatus. One of its features is the "reversed refrigers; on" by means of which water is beated. The woman in picture is pointing to the hast pick-up of this refrigeration unit

ive Adventures with



duced, for a natural-looking habitat group. Near the studio is a patch of semiwoodland; the very spot for a dress rehearsal. There the Jonas brothers took their three black bears, trying them first one way, then another Just as they got them right, they heard a wailing airen A police car stopped at the roadside

"Stop abusing those bears," the

officer commanded

"Abusing?" charused the three Jo-nas brothers, "Why, the bears are dead—and mounted. See?" They demonstrated, "We're taxidermials." "Taxidermists, ch?" the policeman re-

peated. "A woman telephoned you were abusing three helpless black bears."

One taxidermist received, without explanation, a box labelled HAWK-DEAD He bent down, peeped through a slit in

the side of the box. Suddenly, from it daried forth a long, makelike neck, tipped by a sharp bill. It denuthe taxidermist a blow that sent him sprawling blood pouring from a cut

By Thomas M. Johnson

Three black boars, effect vely mounted in Idellity

passe for a museum, are carefully assenged against an appropriate background in a realistic behitel.

OAH WEBSTER said in his dictionary, that taxidermy is "the art of stuffing animals." It is much more than that now, and "atuffy" it never was. At any moment in the taxidermat's life, in may rush adventure or bizarte experience. Nor is this surprising, since taxidermy deals with all manner of creatures, frequently wild, which are sometimes alive when they seems to be dead, and sometimes dead when they seem to be alive. As a few true stories will flustrate.

Not long ago someone sent a rattlesnake to a New York taxidermist to be mounted, Dangerous, but this taudermist knows the tricks. Carefully, he pried off outer boards from the stout express bux. He wore big thick gloves. The snake a handsome damond-back, was powerless, impresoned by the venom-spotted glass Slow y cautiously the taxidermist raised part of it Like a flash the make darted through into a bug strong glass jar whose heavy top the taxidermust clapped down. For an instant, the angry snake thrashed about. Then, the coils relaxed, the head dropped, paralyzed by the two osmices of chloroform the jar contained.

Donning rubber gloves, the taxidermist took out the himp body. He placed it on the workbench, arranged it in various poses, seeking the one in which it would look best when mounted. That found be poured around the black and yellow coils, white plaster of Paris, as the first step toward a wax replica. Then, to hasten drying, he turned the mass over. This left the insensible make's belly uncovered, but the taxidermist knew that long

before the chloroform wore off, the plaster would be dry, the snake back in the box

The telephone bell rang and the taxideensist answered it. A few moments later be returned to the workbench, The mold was on the floor, smarbed into a thousand pieces. The chloroform had worn off, the make a writhings had dashed itself and the mold to the floor of the workroom.

A tiny rostling sound, a rattle, behind him! He whirled, but too late. The rattlesnake struck Luckily help was at hand. The taxodermist was saved and the snake captured after a perilous hunt through the studio.

That near tragedy contrasts with what happened recently to the three Jonas brothers, who are among this country's leading taxidermists. At their large studio in Youkers. N. Y., they had mounted three black bears, for a museum. All were in lifelike poses, eyes twinkling. coats glossy. Next they must be arranged effectively, and an appropriate background repro-



MOLOS READY FOR INSTANT USE sevent his work, the modern treade mis keens on har ! and of an mail heads and bodies of various seasons and shapen



Sies neme of Sienodon pair the encourage he are

Dead Animals

TIME PRODUCING MOUNTED SPECIMENS

between the eyes. The "hawk-dead" was a very lively bittern, whose neck and bill

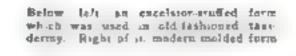
are a formidable weapon.

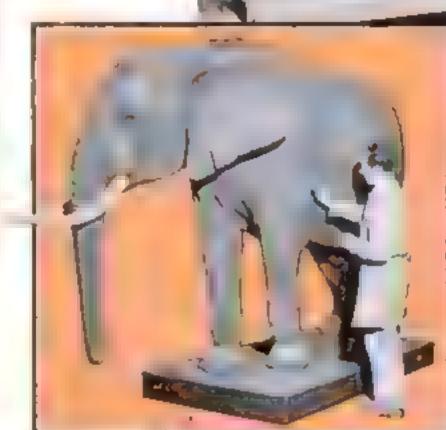
Modern taxidermy, as practiced by its leading exponents, especially for the great museums striving to preserve a record of all the wild animals as they live on their native heath, reaches out very far. It sends into Africa, Ana, South America expeditions of hunters, naturalists, artists, taxidermists, perhaps men who are all four like the late Carl Akeley, James L. Clark. or John Jonas. They not only shoot anmale and bring home their sking and bones, but they also bring the results of a study of those animals at first hand, sketches and photographs of their most appealing postures, of typical and beautiful aspects of their natural surroundings.

These are embodied in babitat groups, scientifically accurate, yet artistically pleasing to the eye. Science alone would give accuracy without Interest; are alone interest without accuracy. Taxidermy secures both.

So a taxidermist, returning from sofert, will bring collections of stumps and branches of trees, buts of moss, rucks, grasses, brushes, feens, even small birds and insects, all to be fitted somehow into a group showing the actual surroundings in real life of the animal specimens, Some things can be dried

Below, adjusting the strings to hold the care at exactly the correct angle to give a 1501 ke appatrance to mounted specimen





This elephant is made entirely of paper. with the exception of the eyes which ere glass, and eyelashes which are hair

and used as they are, but green leaves, flowers and fleshy plants must be reproduced in wax, glass, celluloid, or other suitable materials. while rocks generally are made of plaster matching the sample in color and texture When an animal is shot, each rtem of information that was assist in reconstruction in the museum is carefully recorded -such as some seventy tape measurements of a tiger For the completed group there must be, if possible, not single animals, but groups showing an old male and female, a young male and female, and

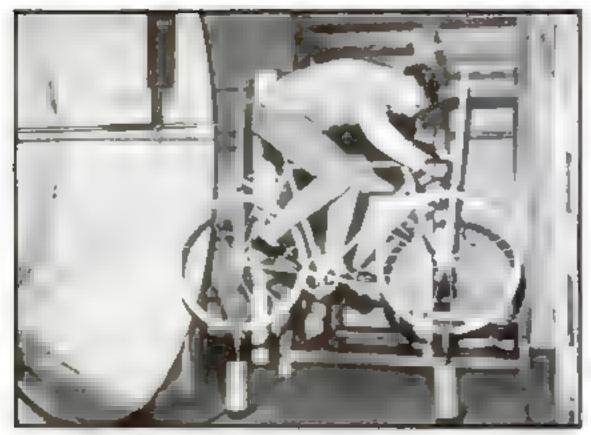
young, to complete the picture. To get them, these versatile tandemists run desperate riska, Clark, now assistant director of the American Museum of Natural History in charge of preparation, has shot pt close range bong, grizzly bears. ther, and other wild am name At fifteen yards he killed a charging rhinoceros Radelylle Dugmure had just photographed. Perched in an acacan tree, he watched scores of anery elephants stampeding beneath, searching fur him. John Jonas has traveled 8,500 miles on safars, and had many adventures. Once he shot a charging rogue elephant.

The revolution in taxidermy that made these efforts and ruks worthwhile, began with the during, artistic, and accentific Akeley Once animals were mounted by placing the skin over a framework, turning it

upside down, and stuffing it with hay or excelsior. Then the animals were modeled in plaster of Paris, and the skin stretched over the dummy. That prevented much

correction of mistakes.

Akeley began modeling animals in clay, Then covered the moid with plaster of Paris in two sections, removed them from the clay model, and lined them with pa-paer-mache and wire netting, making a shell about an eighth of an inch thick This shell, when removed from the two molds and placed together, reproduced the clay model in a light and permanent form. To this form, the tanned skin was applied. Later Clark introduced, and Akeley adopted, wooden ribs within the papier-mache form. The papier-mache models, hollow, (Continued on page 112)



Racing cyclist uses a big wind tunnel in perfecting his speed trahisque

NINE GOLF CLUBS ARE COMBINED IN ONE

Invented by a Chicago jeweler, a new adjustable golf club combines nine different types of irons in one, reducing the assortment needed for a golfer's bag and consequently the weight that must be carried by the taddy Numbers on the swivel head of the club and its mounting indicate the angle of setting for each type of stroke. Thus, when the two 5's are aligned and a sample locking device has been appared, the club is ready for use as a mashie. A telescoping handle permits the club to be adjusted to any length suitable to the player's height



Huse gold clubs are combined in this one

CYCLIST USES WIND TUNNEL IN TRAINING

In occur to study the wind resistance experienced in various postures, a French racing cyclest has availed himself of an nero-nautical wind tunnel for tests. Mounting his machine, which is suspended at the mouth of the wind tunnel, the inder attempts to counteract its force by changing his position. Thus be trains himself to adopt a style that will cause the least fatigue at various speeds in actual competition.



FLOWERS FROZEN IN ICE

FROMEN solid in blocks of ice, fresh blooms of the Australian wattle and bottle brush were recently shapped successfully to London lengland to be displayed at a flower show. The conical blocks were polished as shown above to give visitors a clear view of the contents

VIKINGS' OLD WAR HORN UNEARTHED IN DENMARK

NEARLY ten feet long, a snake-like horn unearthed in Denmark and shipped to America might well puzzle a modern musician. The rare relic, shown below



was used for signaling by ancient Vikings of the eighth century, when they wished to call their adventurous bands together for council or war. A sounding disk augmented its blast so it could be heard for many miles.





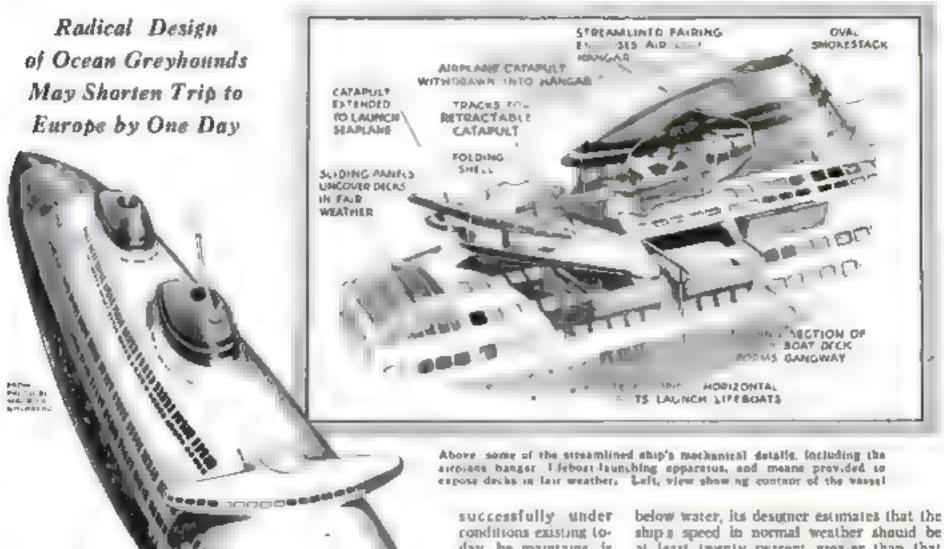
FURNITURE MAKING, HUSTON'S HOBBY

Familian to many for his impersonations on the movie screen and stage, Walter Huston becomes a bome workshop enthusiast in his spare hours away from the studio lot. His cabin in the San Bernarding Mountains of California, where he makes his home, is furnished almost entirely by his own hands. Huston has set aside a commodious room in his basement as a workshop where he produces fine furniture.



Cutaway view of Goddes' design for a arreamlined ship, showing features of liner that will accommodate 2,000 first-class passingers

New Streamlining for Big Ships



RE liners of the see destined to take on new forms in the race for speed? With stream-lined trains and outo-mobiles no longer a dream but a fact, as told in recent issues of Post LAR Science Monthly,

designers are wondering where the newborn art of streamining may work additional transformations. That streamlined ocean vessels will prove a logical development is the view of Norman Bel Geddes, noted industrial designer of New York, who since 1927 has been experimenting with ships, motor cars, factories, and radway coaches designed along advanced engineering lines

Capable of being built and operated

successfully under conditions existing today, he maintains, is a 1,088-foot stream lined vessel that he has designed. Details of this striking craft, which he decribes in his book, "Horizons," published by La le, thrown, and Company give a fascinating picture of what sea travel of the future may be like

Streamlined both in hull and superstruc-

ture, the passenger liner proposed by Geddes presents a striking contrast with present-day vessels. Every air pocket has been eliminated by inclosing the entire superstructure in a streamlined shell Only the navigator's bridge protrudes, and this is shaped in the form of a motoplane wing so it offers a minimum of resistance to the air

As a result of its smooth contour above the water line, and improved bull design below water, its designer estimates that the ship a speed in normal weather should be at least twenty percent greater than that of conventional craft or enough to clip a day from the transatiantic passage. In had weather the advantage of the streamlined ship would be materially increased because it would not be adversely affected by strong head winds. Tests show the design would reduce wind resistance by about eighty percent.

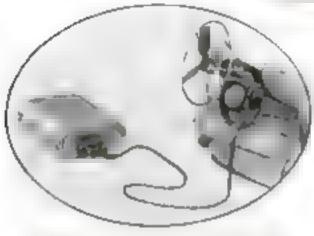
Accommodations are provided on the liner, in Geddes' design, for 2,000 first-class passengers and for a crew of 900 men. Sliding panels of light alloy or glass in the streamlined skin provide for the comfort of the passengers in rain or shine. When the weather is fine, the moving panels are rolled back and the ship is more open than a liner of the present day. In stormy weather the panels are closed and the vessel is as impervious to the elements as a submarine. Thus, the fully streamlined form of the ship is preserved when most needed.

Smokestacks for the steam-turbine power plant of the streamlined craft are inclosed in fairing that makes them seem to dissolve into the superstructure.

Midget Torpedo Boat Has Forty-Knot Speed



CAPABLE of attacking anything from a submanne to a battleship, one of the world's smallest warships has been developed in England. This "pocket torpedo boal," shown undergoing a fest at left, measures fifty-five feet m length and akims the water at forty knots, Because of its speed, it can make an effective escape after a surprise raid. The boat carnes two torpedoes, two small anti-aircraft guns, four depth charges to be used against submarines, and smoke-screen apparatus. Wireless telephone equipment enables the crew of five to keep in constant touch with ships and aircraft. A dozen of the speedy midgets cost less to build than one large destroyer



SMALLEST MOTOR RUNS POCKET ELECTRIC FAN

PAUL WELFONDER, German engineer, claims the distinction of having built the world's smallest practical electric motor Operated by a flashlight battery, its armuture spins at 900 resolutions a minute Mounting a blade on the rotor, the builder has a pocket electric fan,

USE ARROWHEADS TO MAKE PICTURES

AN UNUSUALLY effectevely way to display Indian Arrowheads has been devised by Dr A R. Wattman, of Merrill, Wise, whose collection is the largest in his state The stone weapons serve us the materials for tectorial panels of Indian chiefs, bears, mountain goats, and other scenes and un-mals associated with Indian life. After an artist has traced the outline of the design upon a background of bristol board, Dr. Wittman selects appropriately shaped arrowheads to fill in the design.



This picture of a storm-driven horse and rider was made entirely of arrowheads attached to the canvas by mugns of small wires

ICE BOAT IS STREAMLINED

STYLED the "ice Zepplin," a speedy new type of ice boat has made its appearance at recent German regaits. The pilot sits within a cockpit at the rear of a long torpedo-shaped hull, which has a flat bottom and a top that is rounded to a smooth, streamlined finish. Fatring surrounds the tapered headrest behind the pirot to complete the streamined effect. The odd design gives the craft a striking appearance when viewed head-on, as Blustrated in the picture below,





ROBOT, ON LAND, TEACHES SWIMMING

LEARNING a difficult awimming stroke is made an easy task by a new mechanical instructor, devised by an Oakland Calif., inventor. When the novice lies upon the device and turns a crank handle, jointed guides simulate the motions of the crawl stroke. By following their motion with the lumbs, the student quickly senses the proper timing of each motion, since the guides themselves resist, with gentle pressure, any attempt to make a stroke at the wrong time. The apparatus is designed to give preliminary awimming instruction on dry land, leaving fine points to be taught later

WORKER GOES HOME ON HIS COASTER

At tree end of their day's work, laborers in s slate quarry of north Wales start their trip home in parturesque fashion, Each is provided with an odd device known as a "car gwyllt," literally the car that goes, which is, in effect, a one-man roller coaster It consists of a single sent, an axie, a smal, wheel and a roller Setting this contrivance upon the quarry track, the workman seats himself upon it and whiezes down the mountains, deto the nearby town.





Let us the celler asters even y We so a given to a ding down shoughtst side. Above, workers seadly so start their coast homeoward

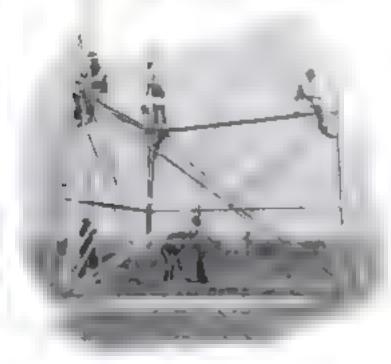
RAISE 146-FOOT TOWER IN THREE HOURS



Right assembling a 146-foot portable tower for surveyors Above, tower up and ready to use

Executed by six men in only three hours, and dismantled even more rapidly to be taken to another site, a new type of steel observation tower is speeding the work of the U.S. Coast and Geodetic Survey. The 140-foot towers are used in long-distance surveying over tall trees and hals to order to

are used in long-distance surveying over tall trees and hills in order to establish permanent location mark era throughout the country. With the completion of this program, no place in the country will be more than twelve miles from a marker



SHOE-SHINING MITTEN CARRIES ITS POLISH

Att the essentials for polishing shoes are combined in a milten recently placed in the market for household use. Small builtons of a special polishing wax are attached to one aide of the milten, as shown in the disastration above, while the other side of beavy flannel serves as a polishing cloth. The two-in-one cleaner is said to give at least 100 shines, and a supplied for use with polishing buttons for either tan or black shoes.



A stop light for cars that is plain y visible in sunlight, fog, rain, or darkness, combines action and dazzling colors to secure the attention of other drivers. Cellusid insets, colored red, blue, green, and yellow, are mainted on a revolving disk that

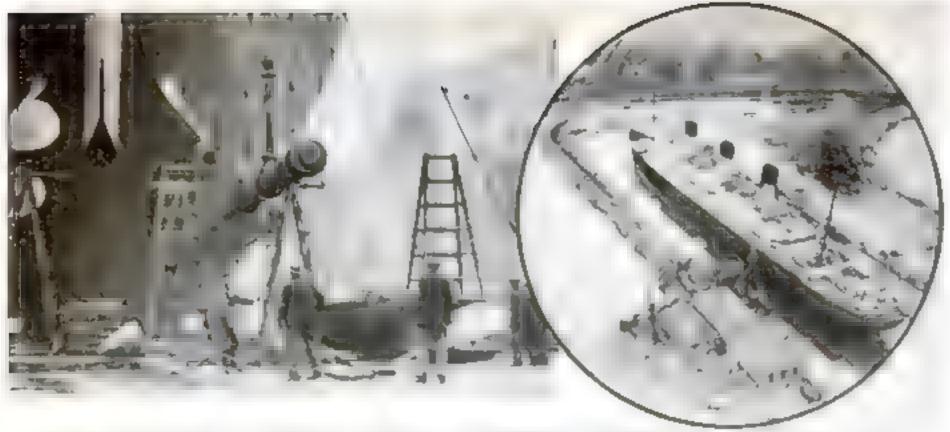


spins whenever the motorist steps on the brake which actuates the signal. A convenient bracket enables the signal to be attached just above the car's license plate, in the manner il ustrated.



PORT FOR GUNS IN

A windshift, containing a gun port, has been invented by a former Dearborn. Mich. fireman, to guard the lives of police officers during a handit chase Thrusting his weapon through the opening in the buliet-proof windshield, an occupant of a police car can fire at escaping criminals without exposing himself. The ball-and-socket port, made of brass, permits a rifle or revolver to be pointed in any direction. At right the inventor is seen demonstrating his model.



LARGEST SHIP OVERHAULED IN WORLD'S BIGGEST DRY DOCK

Two giants met, the other day when the S. S. Majestic, largest beer in the world, entered the biggest dry dock ever built. The shall was the birst to be over hauled in the new dock at Liverpool England, which was recently completed at a cost of more than \$0.000 000. The normal inside length of this dock, 1 200 feel exceeds that of the next largest dry dock, at Boston. Mass, by twen y-n ne et and provision is made for according to a mage that are onto the same for according to the s

GAS MOTOR IN WHEEL TOWS ROLLER SKATER



Mornesized roller sharing a sport packed with thrus, has been introduced in Hollywood talt? A wheel with a minimize book in gasoine motor provides the morive power, and a skater grasping a pair of handlebars attached to the wheel is towed at a lively clip.

4,000 PIECES OF WOOD IN MOSAIC TABLE TOP

By created together 4,000 pieces of fir, mahogany, Tennessee red cedar, walnut and Araska cedar. Everett Smith of Hoquiam, Wash, has produced an attractive card take with a mosaic top. It contains a colorful pattern in five britiant hoes, built up by the small blocks

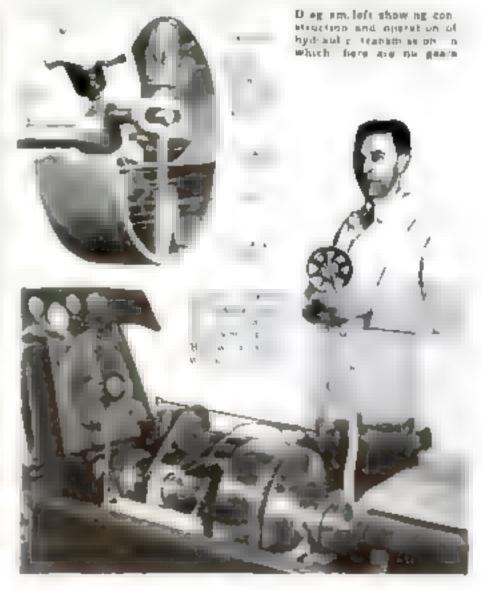


CAP FOR SHAVING CREAM TUBE IS ALSO A BRUSH

SERVING the purpose of a brush or well as a cap, a new attachment for a tube of sharing cream simplifies the morning toilet. When the cap is attached, pressure squarzes cream upon the applicator, which is then used like a brush.

NEW TRANSMISSION HAS NO GEARS

flower is teams. mitted at variable speeds by means of a hydraulic unit in vented by A. E. Hedlund of Everett Wash, Replacing gears in automobiles. it employs a steel case containing eight cylinders with eight pistons working to pairs from a crank attached to a drive shaft. When this drave shalt is rofated a reciprocating motion is set up m each link acting between opposite es inders, thus caus ing one cylinder of each set to pump oil, while each upposing cylinder expels it. In the wall of each evlinder is p wedge-shaped port which may be closed or opened. When these ports are open. the unit runs free but as the port is closed, it takes up the load



USE WINGLESS ROOSTER IN STUDY OF FLIGHT

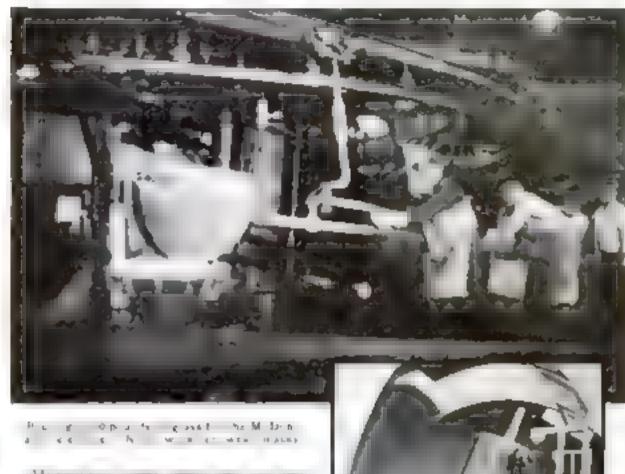
THROUGH a freak of nature, science may soon be able to explain some of the long-standing mysteries of the flight of hirds. A rooster hatched without wings, is now to be studied in the National Zoological Park at Washington, D. C., by experts from the Smithsonian Institution. Six months old, it has shown no incanation to try to fly. Later, by dissection, the experts hope to find why the wings failed to grow and whether the absence of flying instinct may explain the evolution of flight



NEWEST SPEED TRAIN LEAVES THE FACTORY

SHAPED like a projectile, the Union Pacific Rai road's 110-mile-an-hour stream. I ned train has just been completed in Chicago. Its first picture, reproduced above, gives a striking impression of what the swift moosier of the rails will look like when it is coming down the rails directly toward the observer. The wide semi-circular ports at the front ventilate the cooting system of the train's 600-horse-power motor, which is directly coupled to a generator providing electric current for its propulsion.

POUR THREE-TON TELESCOPE MIRROR



Market of the second of the se

Complete scale model of the McDonald telescope. Its mirror will be world's second jargest

FOG PIERCING CAMERA TESTED ON SEA CRUISE



Williams' fog comers to use on liner Manhetran. Upper right, developing picture in thirty seconds.

Walter Street Straight and IN FOR A PIN A FLE L H (S M | 20 11 45 and the same to the Kar Kah Mall the Co and a special transfer and the e this transmit is the act of to mer of an a When tog чтин в стем с ога фасциаor a later a company of the he new camera is brough and a . Its pature can be develgied and fixed in thirty seconds. a show what is ahead of the hip, and reveals objects from two of lour times as far away as one can see. This is done with plates sensitive to invisible rays.



A PRINTS S . SIN T

serious work. As microscopes are used in commercial and government laboratories in examining and testing all kinds of materinks, so you can employ your instrument for analyzing food, cloth, paper, and hunureds of other things found in your home

It is fun to examine, at 100 diameters. a bit of fuzz plucked from your cost. At the same time, such an examination may show that you have been cheated that the suit the merchant assured you was "all wool" really is a mixture of wool and cotton. In the same way you can learn, more certainly than in any other, whether many other articles are genuine or, in the case of food whether it is fit for use

To be your own microanalyst, you need not possess elaborate equipment or be an expert scientist. Even the most highlytrained microscope specialists employ a system so fundamentally simple that anyone can follow it. Hasically it is

Compare the unknown substance with known materials until you find a perfect match

Thus by looking through your microscope at specimens of cloth, starches, paper, foods, and other substances whose dentity you know exactly, you soon learns to recognize these things when you meet them in strange places. It is like belonging to a club. You soon learn to recognize on sight, all established members. Some day you will encounter a stranger among the group of club members, but if you go about it in the right way, you will not find it particularly difficult to identify him. Similarly, you can learn the identity of the strangers you find under your microscope by comparing them with known substances, with pictures, or by further observation

When you first start out to discover

V 90 21 V 2 W 10 or whether the refug efaior contains gay thing that is not fit to cat, everything you meet will be more or less strange. Maybe

you think that you already know all about the common things you will find-shout a potato for instance, but soon you wall discover that you previously knew almost

For darbibeld l'lumination accons

your light, an above, so it will strike

the object obsequely. The cardboard

sa coud to chierd the eyes from Light

Here is a small Irish potato a common spud. Look at it, If you can, by stretching your imagination, decide that it is an object of beauty, you deserve a medal for you have rare insight. It is beautiful and interesting, but not as it stands. With a knife cut a small piece from the potato, scrape the surface until you have a drop of cloudy liquid, and smear some of the liquid on a microscope slide. Into about one tablespoonful of water stir one drop of tincture of jodine. Add a drop of this musture to the potato scrapings on the shire and place a cover glass over it With your unaided eye, you can see the smear take on a blue color. Now put the slide on your microscope stage and adjust the magnification to about 100 diameters. Who said a potato has no beauty?

The blueish smear has resolved itself into a collection of hearly round jeweis. sapphires they seem to be. They are not all of the same size, nor exactly of the same shape; but all are nicely rounded, with no sharp angles or tagged contours.

These particles are potato starch grains. colored blue by the sodine. This coloring action is a standard test for starch. You can add todine water to any food or other material, and if there is starch present, the characteristic blue color will appear

Examine one of the grains carefully, at

a higher power if poss ble. You will discover that, like an oyster shell, it is made up of

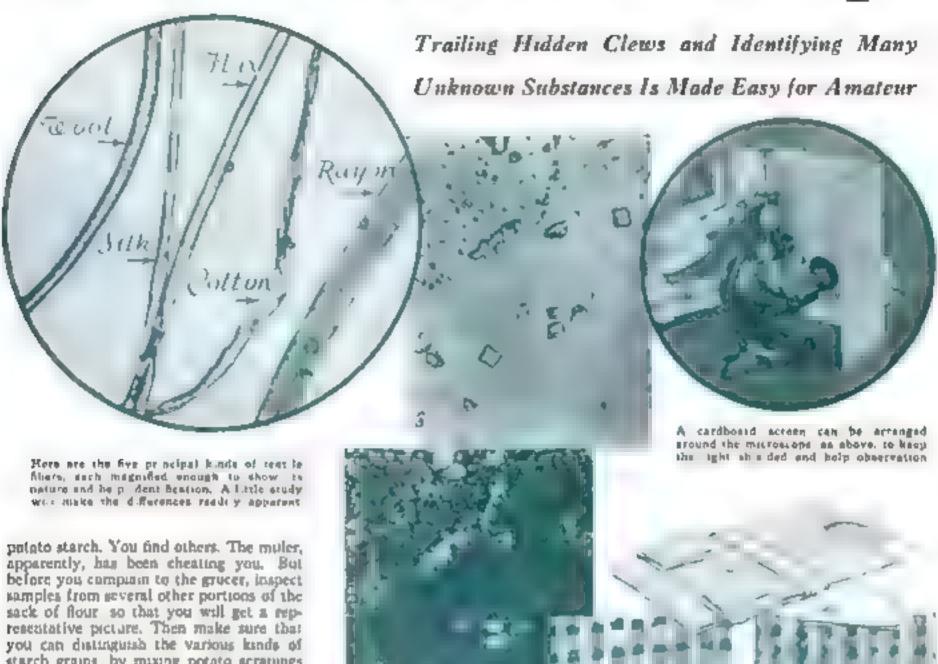
concentrac layers. Near one end of the ediptical grain, you see what appears to be a dot or hole. This is the hilum present in many kinds of starch, Potato starch grains are among the largest of any starch. Their surface markings are more distance than on most other starches

Make yourself well acquainted with potate march, for you may meet it almost any place during your examination of household foods. Here, for example, is a suck of flour about which you know little or nothing. Is it pure? The microscope will answer that question if properly used, even when chemical and other methods might fail. Flour itself is composed largeby of wheat starch, but sometimes the miller can make a greater profit by mixing some cheap potato starch with the flour You cannot see the difference with your unaided eye; nor can you feel, taste, smell, or otherwise learn that there is a difference. But your microscope will tell you the truth at once

Sprinkle a little of the flour on a glass slide and mousten it with a drop of the sodine water previously mentioned. Dropa cover glass over the specimen. Your microscope will reveal numerous blue partitles, counderably smaller than the grains of potato starch, and more or less cir-cular in shape. These are wheat starch grains. Perhaps you can see the hilum and layers of one or more of the grains.

Here in the flour is a blue grain that is much larger than the others. It looks familiar, and you identify it as a grain of

Your Own Microscope



starch grains, by mixing potato scrapings and wheat flour together, and examining he mass under your microscope

Because starch is one of the commonest materials used for adulterating granular foods, you must make yourself familiar with the other common forms before you can with certainty analyze foods. Legizninous plants, such as beans and peas, contain a starch that is different from other forms. The grains usually eloptical inshape, have a akt-like in are instead of the circular form found in wheat and potato starch. You probably will not be able to see the rings or layers.

Cornstarch, and that made from rice, are very much alike, but differ from other starches. Their grains are small and are irregular, with sharp corners and edges, and there is no visible layer structure Grains of rice starch can be distinguished from cornstarch by their smaller size, and their tendency to clump together, Still another form of starch is that occurring in tapioca. The grains, about the mae of those of cornstarch, resemble, for the most part, hard-hoiled eggs from which a portion of the small end has been cut That is, they are nearly spherical in shape but have a flat place which projects a little. The microscope reveals a dot or bollow at the center of the grain.

Starches are not the only foodstuffs you can analyze with your microscope. Perhaps you have a sample of butter that you know bille about Smear some of it on a

warm slide, and drop a cover glass over it. The microscope quickly reveals whether the butter is salty or sweet. If it is salty, the cubes of sodium chloride (table salt) will show distinctly, like crystal blocks. Pure butter is made up, for the most part of small particles of fat and globules of water, evenly distributed. Butters which are composed partly of margerine or other fats and nils usually do not show such even dastribution. The water globules generally are larger than those of fat

Center top solt particles

n butter seen by transm t-

ted light. Above, the same

specimen as seed with a dark treid suminat un

These two kinds of light

on are expired to text.

Look at ground coffee under a low power, and you will be able to determine roughly whether or not it is pure Among the materials used as an admiterant for genune coffee are chicory bran, burnt sugar and particles of the roffee plant. Small particles of cuffee bean, under a high magnification, are seen to be made

up of thick-walled cells containing tiny droplets of an oily bound. The other substances used to cheapen coffee do not contain such cells. Chicory for example, has cells with walls that look fragile

Above oil shirt of cayon and corron, and above right ab rt

of linen. The threads of each of these three different fabrica

can be identified if separated and viewed with a microscope

Sugar sometimes is adulterated with starch, and even white sand has been used, although rarely. You will have no trouble detecting starch by the sodine method.

Microscopic examination is an important means of controlling the purity of milk and cream handled by dairies. Usually the anteroscope is used to detect the presence of undesirable bacteria, and to indicate excessive numbers of white blood corpuscles which are produced by cowa having abnormal or diseased udders. For such discoveries magnifications beyond the range of the (Continued on page 104)



EARTH GUARDS DAM FROM QUAKES

THOUSANDS of cubic yards of earth and rock, now being thrown against the concrete base of the Mulhodand Dam in Weid Canyon, Calif., will soon nearly cover the giant structure. The unusual engineering operation is carried out be

cause the dam has in a section where known earthquake faults exist, and the earth blanket will protect the thickly poptited regions further down the valley in case a quake weakens the dam. The photograph shows the blanket being applied

SEEK WAY TO SILENCE AIRPLANE PROPELLER

To FIND out why airplane propellers make as much noise as the motors that drive them, and to learn how to correct it. General Electric engineers recently installed at Languey Field Va., the unusual testing motor pictured below. For test a propeller is attached directly to the shaft of the motor which can be turned in any direction, and whirled at varying speed and its noise recorded.



SMUGGLERS DETECTED BY X-RAY OUTFIT

Bibbest jewelry and contrabond materials cannot escape the eye of an inspector armed with X-ray apparatus such as has recently been inscalled in Dutch customs houses, to thwart the wiles of smugglers. Each traveler is obuged to submit himself and his luggage to examination, as shown above. Honest tourists are thus expedited in their passage through customs while those who have concealed undeclared valuables are caught red-banded.

TEST RADIO-OPERATED TELETYPES

TRANSMISSION of weather reports and other data between the nation's many airports, by means of tele type machines, or automatic typewriters, is now done over land wires. Huge sums may be saved if experiments in opera ing the teletypes by rad a prove successful. Recent advances in radio technique have shown this possible and its practical applica tion would dispense with 13,000 miles of leased wices now in service. At right. government oir of beats are examining one of the first weather maps sent over the new radio teletype.



Covernment affectate examine weather map said by radio to c you



GLASS COLORED BY SUNLIGHT

COLORING glassware by the action of the sun's rays has become a profitable occupation in the deserts of the Southwest. The picture at left shows one trader's cache of bottles and flasks, whose clear glass will turn to a purple or amber after two to five years in the sun. The glassware then brings high prices. Scien ists explain that the ultra-violet rays change the structure of the glass

Defy Death in Stratosphere Flight



Then en the first Russian fintloop and gondo's used when a new abstude record was at elt and right he ped the accentiate in their take off

Left Major Chaster L. Fords they landed from thair

ney and Lout Commandat stratubphers flight surcessful

cently, and paid with their

lives for the venture. Others are ready, none the less, to carry on the task of exploring this future airway. The two Army airmen who plan the new venture, Major William Kepner and Capt. Albert W Stevens, will seek their record in another enclosed gondola. Meanwhile a Spanish aspirant to stratosphere honors may precede them with an even bolder scheme of exploration.

To protect himself from the low atmospheric pressure at the twelve-mile astitude he seeks to reach, Capt. Emilio Herrera of the Spanish aviation service proposes to swath himself tightly in handages from head to foot. So clad and covered by an electrically-heated diving suit, he believes he can make the ascent safely in an open basket. Workmen already are rushing to completion a balloon for his pertious venture, in the enurse of which he plans to make photographs of scientific interest keeping in touch with the earth meanwhile by radio,

A number of small balloons, like the one shown above, well be released by experts in a comprehensive study of the attainaphere. The instruments they carry will automatically record weather condition. Bamboo frames protect them

So successful were these first flights that few realused the peril involved, until three Russian aeronauts set a new thirteenmile altitude record re-

and allowed a balloon to carry him ten miles high, he showed how explorers

could conquer this little-known region. After he had duplicated his own feat in

a second attempt, others tried it. Russian

aviators rose to a record height of almost twelve mues in a seased balloon gondola.

Two Americans, Lieut Commander T G. W. Settle and Major C. L. Fordney,

nearly equaled this alti-

tude feat with a similar outh! One of the dis-

coveries made in these

ascensions was that the air at such heights, though

thinner then near the ground, contains practical-ly the same percentage of

oxygen, a fact important in designing stratosphere

surplanes, since it showed

the air at such levels

could be compressed and

supplied to occupants of

an enclosed cahin, allow-

ing them to breathe without the use of oxygen

apparatus.



SAILING LEARNED ON DRY-LAND VESSEL

Youngsters may enjoy the fun of sailing and learn its art, without the danger of actually putting to sea, through the invention of the realistic dry-land craft shown above. Any back pard serves this captive boat for a lake, and its time sails puff out in the wind as gracefully as if it were floating on water. A frame supports the craft through a universal joint allowing it to heel over in the breeze and to be steered toward any point of the compass exactly like a real boat.



SUN BOILS WATER IN 45 MINUTES

Dagasts of harnessing the sun for the practical development of power are brought nearer realization in experiments now being conducted by Russian scientists. Solar boilers of a new design, in-

stalled in a desert station, have heated water to the boiling point in forty-five functes, and attempts are now under way to apply the plan on a larger scale. The pacture above shows the boders.

ALUMINUM MADE BRIGHT AS SILVER

Att mixt at is given a brightness that approaches that of silver through a newby discovered process, which is expected to have far-reaching industrial applications. Its first use will be in constructing reflectors for floodlamps. The metal is

cret chemical bath through which ries the resulting electroletic action dissolves out the impurities in the action in an and leaves it with be extraored bary brilliancy. By repeating the process a weather-proof coating is added.

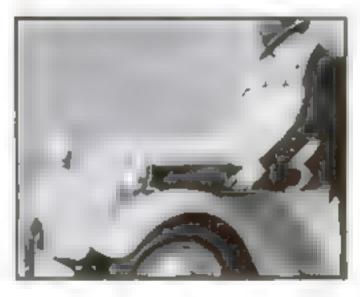


ANIMAL PAINTERS HAVE ART SCHOOL

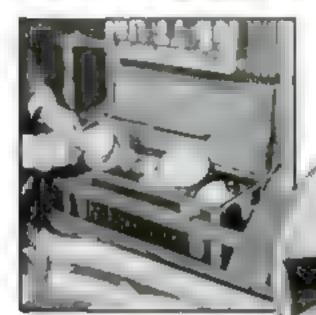
Cows and horses serve as models at a school for animal painting in Munich, Germany, called the only one of its kind Students entering this school embark upon a five years' course designed to teach them the fine points of painting domestic animals. In the mornings, a borse serves as a model.

THREE-WHEELED CAR HAS SPARE TIRE UNDER HOOD

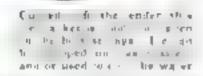
THREE-WHEELED cars, popular in Germany because of their economy, present an unusual problem in the pincing of the space tire. One manufacturer has solved it in the ingentous manner pictured below. The space is supperfoul of the way in a special compartment just under the hood.







A fla gar ne ar se on a gar at at re a y e ar a war e i w a a b cure a b rabitan



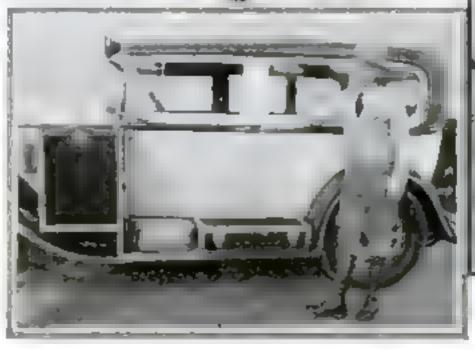




F leng ha h
1 4 1 95 4 8 6
5 4 8 6 185
6 4 8 6 6
7 4 7 5 185



On the rinking has a seen or a seen and a commer Time are no arranged they as not reverse with he located



At the back of the car is a cuth-covered rentainer of while tive gallons of water are correct. A succe makes it an easy matter of area will do a

TRAVELING SHORT-WAVE OUTFIT

WHEN L. A. Morrow radio amateur of Springfield, Ohso, goes traveling, he takes his radio station W8DKE with him. To compare the results of short wave transmission and reception in different parts of the country, this enthusiast transformed his outfit into a station on wheels, housing it in a two-wheel auto trailer that he constructed of pressed wood material on a wooden frame. To erect his 66.5-foot antenna, he has only to set up a jointed pole carried in the trailer, attaching the other end of the aerial to any convenient tree. When a 100-foot flexible table is connected to the nearest electric light line, the station is ready for operation.



FLYING CONDITIONS OF NATION SHOWN ON MAP

KEPT up to date by frequent weather reports, an unusual map just instailed at the Rome beadquarters of the Italian Air Ministry shows nation-wide flying conditions. Symbols inserted upon a map of Italy at the location of each observing station insicate visibility wind direction cloud height, and other factors important to acrial navigation. A glance at the chart gives a clear idea of flying conditions all over the country

TESTS GAGE STRENGTH OF NOTCHED JOISTS



Testing the comparative strength of joists after they had been notched in various ways, experts of the U S. Forest Products Laboratory recently discovered a fact important to home builders. When Jousts are cut away at the ends in order to lower a floor to a desired level, the

to make a rectangular notch. New tests reveal that this leaves the jost weaker than if an additional section were cut away. Trials showed that if the joist in the top view could support 1,000 pounds, the one below it rould hold a load of only 250, and the bottom one 500 pounds.



WOOD MODEL SHOWS BEHAVIOR OF GAS

At the University of California, a student has constructed the carious model illustrated at the right. It shows graphically the behavior of a substance in its various physical states. Sections of ply wood, of which the models is built up, are stomed in four colors to indicate the action of gas, liquid, and other forms in which carbon chouse exists. A hinted joint permits the model to be opened for inspection at a point at which gas forms.





USE PROFILE SHADOW TO EXAMINE GEARS

To percentive whether small gears, ratchet wheels, and other irregularly shaped objects correspond to the designs used in their manufacture, a desk-type profile projector has been developed. The object is placed on a glass platform as at left and its magnified shadow is thrown through a system of micros, upon a translucent screen. By placing a large-scale drawing as tracing upon the screen, the outlines of the part may be directly compared with that in the drawing. Special illumination permits interior features to be projected and examined.

STRIKING VIEW OF NEW SUB

Latest addition to the British Navy, the powerful submarine Severa slid down the ways at Barrow-in-Furness. Engand, the other day and was snapped just after the launching, in the striking view reproduced at the right. A towering prowand building sides give the vessel a fantastic appearance. Besides its torpedo tubes, the Severa carries deck gues of sufficient caliber to make it a respectable adversary in surface combat with enemy destroyers.

BOOK FOR TYPEWRITERS

HELPING children to learn to read, write, and use the typewriter is the threefold purpose of a picture book just published, which is called the first of its kind. Its perforated pages may

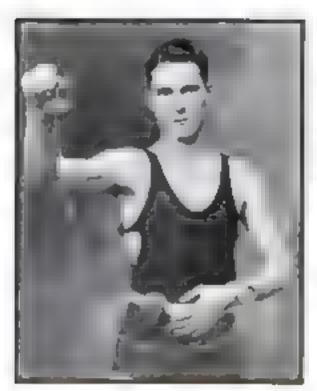




England's newson submarine photographed immediately after it had been leunched. Note to building a deal giving an unutual appearance

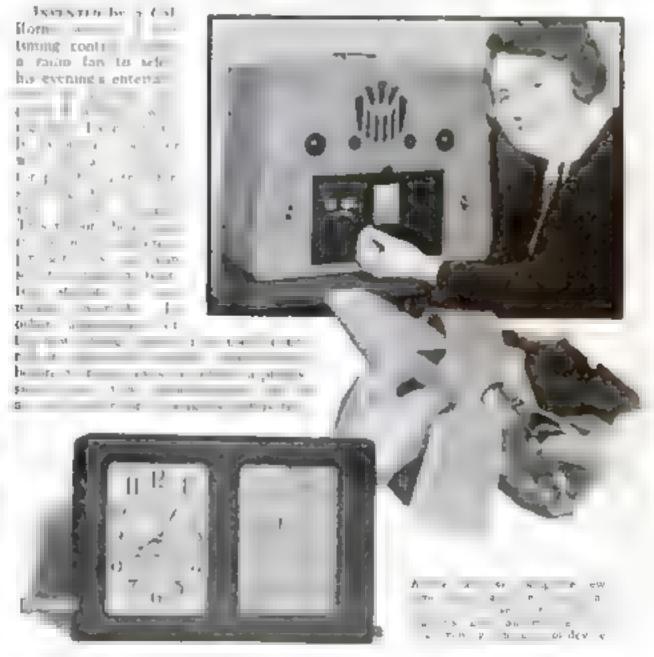
SWIMMER'S LIFE LINE IS WORN ON WRIST

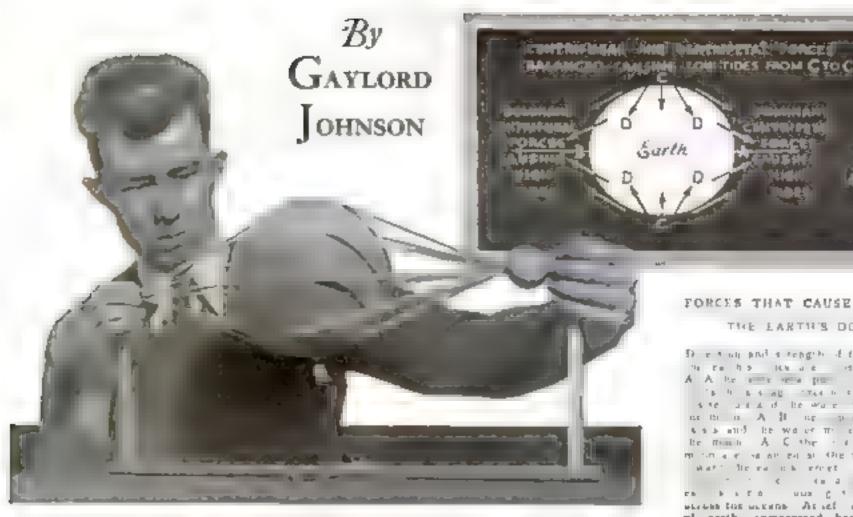
Work on the wrist or belt a new life-saving appliance aids in the rescue of a swimmer in distress. The device consists of a cork float and handle, a coil of light but tough cord, and an aluminum receptacle. If the bather feels himself sinking, he pulls the float from its cup at the instant of calling for help. The cord unstant of calling for help. The cord unstant of the surface, as soon as they reach the float, thus materially speeding the recovery of a drowning person.



Life line, with fort attached, in worn in a cup on swimmer a write for use in need

TIMING CONTROL DIALS RADIO FOR YOU





RUBBER BANDS, A BALLOON, AND A GOLF BALL SHOW . . .

FORCES THAT CAUSE TIDES IN THE EARTH'S DOEANS

The sumport a sength of the anished "B " B S WE "TES D F e eaof earth compressed brewsen rubber bands shows how he watery envelope of the tarth to distorted by centripital and trait-fugal forces of the earth and moon

How Moon and Sun Generate the TIDES

F VOU ask a school boy what causes the tide in the ocean he will tell you, "The moon, of course! The attraction of the moon pulls the water of the oceans toward it. The attraction of gravity beaps up the water on the side of the earth toward the moon and so the tide rises as the waters pile up."

That is about all that the boy's knowledge covers. You will puzzle him if you ask, "Why are there two high tides every day, while the moon is crossing the oceans only once?" This question will also puzzle nine out of ten grown people.

The tenth adult will try to explain that there as another heap of water on the other side of the earth, the side away from the moon. Then he will add that the two heaped-up places in the ocean account for the two daily flood tides, while the low places in between account for the two daily ebb tides. Probably this will exhaust the exceptional adult's familiarity with the mechanical activities of the moon, sun, and oceans.

Yet the forces that produce the exceedingly varied tidal movements to be witnessed daily on the coasts of all the continents can be illustrated clearly by means



of a few ordinary objects easily obtained. If I drive a staple into an old golf ball, tie a string to the staple, and whirl the ball around my head, the string is thrown into a state of tension, which faintly suggests the force of gravity acting upon both the earth and the moon. We will disre-

gard the sun for the present If I which the rolf ball so violently that the staple is pulled out, the ball will fly off in a straight line, a line which is a tangent to the circle in which it was forced to travel by the string. The moon would do the same thing if the force of gravity which holds it to the earth were to be suddenly annihilated.

CENTRIFUGAL FORCE CENTRIPETAL FORCE

If we make a picture of the forces acting on the ball and my hand, through the string, it will look something like the illustration in the center column of this page. Bear in mind that everything which is true of these two forces will still remain true if we imagine my fist replaced by the carth and the golf ball by the

The force represented by the arrow A would, as we just saw, make the golf ball fly off at a tangent if it were suddenly released from the force of my hand acting in the direction of the arrow B. These two forces struggle against each other and constantly compromise by drawing the ball along the curve of the dotted arrow C. I have drawn the arrows of the same length to show that the forces A and B are balanced, and therefore equal in strength.

I can feel this moon against earth struggie taking place in the string as I whirl the ball around my head. The momentum of the ball tries to resist the force my hand exerts to keep it traveling in a circle.

Can we represent the contest in the string? Certainly 1f, ignoring the circular motion of the ball, I try to represent the two opposite forces that struggle in the



AMPINIOGIAL

COMCES

CENTER OF GRAVITY EFFECTS THE TIDES

History on above those how the earth and mount pavo we about the resumment of the resumment

responsed by the last ing needle. Two today harges, which do now the moon represented by the paper cop surrounding the globe travel as great waves across the earth a octane. Diagram suggests thanner in which parth moon system in high in constant balance.

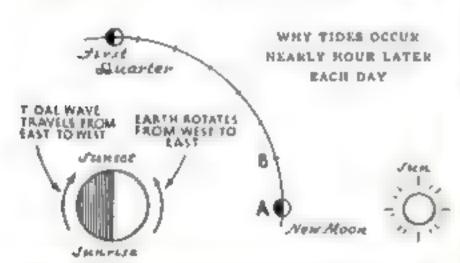
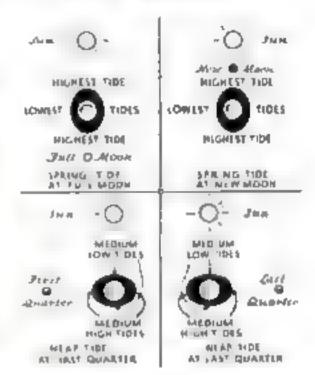


Diagram shove shows how moon records from A to B up 24 hours, while he wanth rotates once on its auto. As a result the moon sizes about 50 m nutes agent such night. In tides also will rise later

Mechanical Forces That Pile Up Oceans on Every Sea Coast Twice Each Day Are Clearly Explained

HIGH TIDES EXPLAINED

Two upper dia grams at fight explain high tides as the result of the gravitational pu I of the sun acting in line with that of the OPINIO III. These are ca fed Spring rides. The ree lower disgrams show the sun's force acting at right angles to the moon a effect. The result is seen in the low tidal waves called neap I dat. Note, the muon exerts the dominating for ver the ocnou dited a





I lustration above above how the tidal wave storts principally in the fouth Pacific moves into the Indian Ocean, rounds Africa, and passes up the Atlantic, Thence it awarps around South America to the Pacific Ocean

cord, they can be represented by two arrows of equal length, pointing an opposite directions, as shown in the drawing at the bottom of the opposite page. We will call the arrow A the centrifugal force, and the arrow B the centripetal force

When we imagine that the cord attached to the staple and held in my hand is replaced by the force of gravity acting between earth and moon, we must take an admitional condition into account. In other words, the string is not a perfect symbol for this bond of gravitation.

Why? Because the centrifugal force of the whirling gulf ball pults my hand at the single point where my fingers grasp the string. And in the same way the centripetal force of my hand drags upon the ball at the single point where the string is tied to the stapse

The cord is not a perfect comparison for the force of gravity because the bond between our heavenly bodies does not act from a single point in one to a single point in the other. Every particle of the moon attracts every particle in the earth.

Let us put it a little differently, for convenience, and say that the sum of all the particles in the moon (or the entire moon's mass) attracts the various parts of the earth with forces of varying strength. The strength of these forces will vary according as the parts of the earth are nearer or farther from the moon. The nearer the parts to the moon, the more strongly they are attracted, and vice versa.

Moon

On the opposite page is an illustration of this situation. The earth's radius being 4,000 miles, the moon is distant from the earth's radius, or 240,000 miles. Then the moon is distant from the far side of the earth by surty-one times the earth's radius, and from the near side by only fifty-nine times the earth's radius.

Accordingly, the water of the oceans on the near side of the earth will be attracted to the moon by a slightly stronger force than that exerted by the everage attraction of the moon for the center of the earth. Also the waters on the far side of the earth will be pulled toward the moon by a slightly weaker force than that which the sateline exerts at the earth's center

It is these differences in forces that cause the tides.

In the illustration at the top of this page, you will see that the moon does not

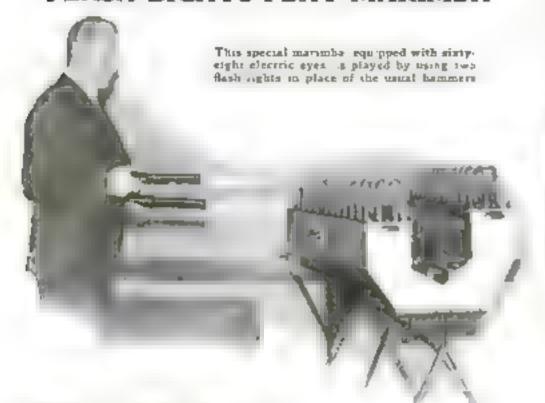
really revolve around the earth's center but the earth and moon both revolve around their common center of gravity (P S.M., March, '34, p. 40). Accordingly, both earth and moon tend to pull away from their common center of revolution with centrifugal forces, and both are bound to their center of revolution by centripetal forces.

When you understand this point, you will understand how the tides are caused, for the waters nearest the moon are attracted by a centripetal force stronger than the earth's average centrifugal force. Accordingly, the waters are raised toward the moon in a beap.

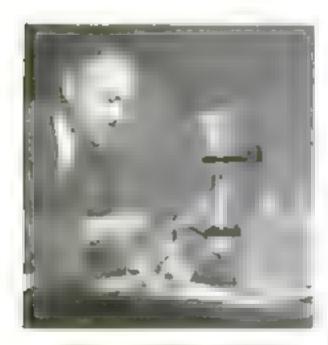
Now take the oceans on the opposite side of the earth, on the side away from the moon. There the waters are attracted by a weaker centripetal force than the earth's average centrifugal force. Accordingly, the waters are thrown away from the earth by the dominating centrifugal force and rise into a heap which piles up in the direction away from the moon.

After the effect of the moon's attraction upon the oceans is clearly understood, it is easy to see how the sun's pull modifies the height (Continued on page 111)

FLASH LIGHTS PLAY MARIMBA

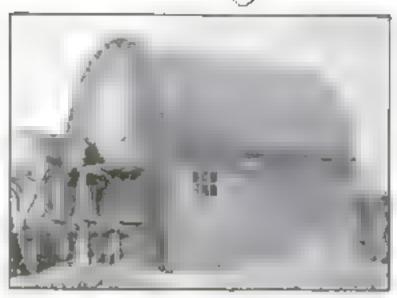


Hotbing flash lights instead of hammers in his hands, Dr. Philips Thomas Westinghouse research engineer, recently demonstrated a new type of musical instrument that can be played with hearts of light. The instrument, a special marinha, has been fitted with sixty-eight electric eyes and ampulying tubes. Whenever a light beam falls upon one of the cells, a corresponding tone of the marinha is nutomatically sounded. Through this unusual prrangement, a practiced player can render even complicated melodies.



SMELL METER TESTS PURITY OF WATER

Fan more rapid than any known method of chemical analysis, for detecting impunties in drinking water, is a new "mell meter developed by Harvard University experts and clustrated above. Consisting of an air pump with a mercury piston, ir first is falled with pure air. Small measured quantities of the water under test are then introduced, and an observer notes the moment at which the first sign of odor can be detected. One of the first tasks of the new meter will be to investigate more thoroughly a recent discovery by chemists connected with a New Jersey water company hat a badly insurated underground wire or even a radio grounded to a pipe may turn wa er pink blue, or green and give it an undesitable odor



NEW TYPE BARN IS FIREPROOF

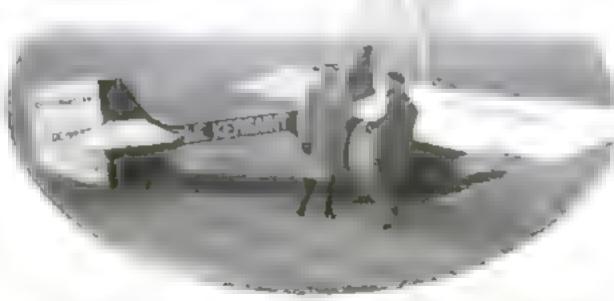
DECLARED the first of its kind, an experimental barn, built by an association of brick manufacturers, is undergoing tests near Busington, N. J. Because of the new type of brick construction used, no supporting forms were required in its erection. Walls, floor, and ceiling are reinforced with steel rods, which also aid in supporting the roof.



IMPROVED CLAMPS HOLD HARNESS FOR SEWING

To all farmers in repairing their harness, an inexpensive and practical substitute for the old-fashioned statching horse
has been invented by Prof. L. M. Rochl,
of the Cornell University Department of
Agricultural Engineering. His new clamp
is mounted by means of three acrews to
a sawhorse or board, which the overator
straddles to use the tool, as shown at lef
Pressure applied with the left leg clamps
the movable faws upon the work, the jaws
being tocked by a self-acting latch bar,
When the work is done, the har is lifted
with the right knee and the jaws automatically apping apart

Two hinged vance on a man above the wing costs. This grains ha it cannot sup ut pick



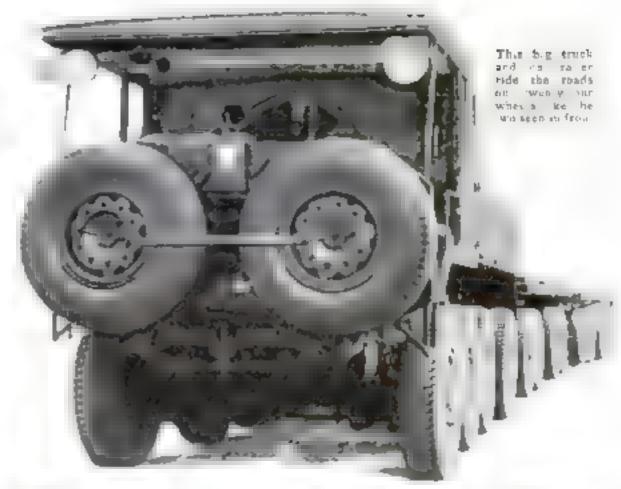
VANES ON MAST KEEP GLIDER LEVEL

Successful in its first test flights, a garler with an unconventional statu izing device has been introduced by a French inventor. The stabulzer carried on a mast above the wing is used to correct any tendency to pitch forward or side-slip in flight I s two binged values are so wired that they may be folded flat or spread sideways by a control in the hands of the phot and thus stabilize the plane

NEON LIGHTS ON RADIO MAST WARN FLYERS

To porestall an aerial accident such as recently cost ten lives in Belgium, when an air liner coilided with a tall radio mast, the towers of the broadcasting station at Rugby, England, are being equipped with neon danger signs. The glow of the tubes, shown in the photograph below, will warm airmen to fly high over the station.





TRUCK AND TRAILER HAVE 24 WHEELS

Viewen from the front, a new truck introduced by a British manufacturer appears to be al. wheels. Twenty four in al., support the truck uself and the two trailer sections with which it is furnished, enabling the remarkable vehicle to maneuver with ease over rough and schom-traveled routes. Two spare whee a carried at the front of the machine enhance is grotesque appearance. The truck is powered with a motor that operates upon oil fuel and develops 130 horsepower



CHEMICALS NOW REPLACE HOT IRON IN BRANDING CATTLE

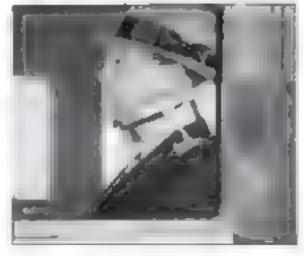
has been made more humane by the introduction of a chemical compound that takes the place of a bot iron. A cold tool is dipped in the chemical and applied to the animal's hide. Within a few days the powerful compound painlessly eats away the hair and turns the red skin to white, leaving

> a permanent and indelible identification mark Cowboys of the old-fashioned school distrusttul at first of the new method have come to approve if because the animats. feeling no pain are far Her to handle and the job is more expeditrously done



METAL COLLAR SUPPORTS CAR DRIVER'S HEAD

Long-distance drives are made less arduous for the motorist, according to a Cincinnati, Ohio, inventor, by a shockabsorting headrest that he has devised A hinged metal collar lined with soft material maps about the neck of the driver, supporting his chin and the back of his head upon his shoulders through spring arms. In addition, the inventor declares, his device makes a night driver less Likely to be overcome by sleep



METER ON STILTS GAGES RAIN ON MOUNTAIN TOP

SET high on stilts to clear the accumufation of drifts that might otherwise bury them, pot-shaped contrivances, like the one il ustrated above, serve to measure the fall of rain and anow in the Swiss Alps. Every two months an observer makes the rounds on skin to note the precipitation that they record. The station shown in the photograph is situated more than 13,000 feet above sea level in the Alps Mountains



MAN ENTERS WHALE TO TAKE IT TO PIECES

WHEN a guant whale was recently moved from its accustomed place in a Braish museum to a new location, an attendant was called upon to play the role of a modern Jonah, Entering the cavernout interior of the monster, as shown above, he aided in disassembling the massive bones of the skeleton from their mounting. Each of the bones was carefully numbered before removal. The task of moving one of these creatures is appreciated when it is realized that the head of a whale, alone, may weigh a too,

MAPLE-SEED CHUTES DELIVER AIR MAIL

WATCHING the seeds of a maple tree spiral gently to earth, Kennet J. Gardwood, of Bethlehem, Pa., saw the possibility of copying these natural parachutes for practical use. In consequence, he has just received a patent upor a revolving parachute for dropping letters an small packages from speeding planes, Made of

reinforced fabric, its design follows atmost exactly the seed pod that furhished its inspiretion. Places that have no landing field can receive their mail and supplies by means of these chates, the inventor points out The harder they are thrown into the air, the sooner they start to whirl, and they may therefore be dropped from tow altitudes that would not give the standard type time to open.



USE AMERICA'S WORST ROAD TO TEST CARS

To Darnott, Mich., goes the dublous distinction of possessing what is called the worst road in America. Just completed by a motor car maker for testing new models, it appears innocent enough when viewed from a distance, as in the picture at left, but a ride upon it represents a motorist's nightmare. Suppery paving invites a skid, and made-to-order ruts and bumps pound tires and springs. When his latest machine has proved its worth on thu road, the maker is reasonably sure that it will stand up on the public roads.

LAKE SHELTERS MILLION DUCKS

Brotting out the sun with their wings, wild ducks fill the nor at a private sanctuary maintained by George H. Wil-COR, Arkansas bird lover More than a midion, he estimates, visit a lake on his properly near Stuttgart during the winter, The photographer snapped a goodly por-Lon of them in the remarkable view reproduced at the right. Assisted by two aides. Wilcox patrols has preserve to keep hunters from molesting the birds that are enjoying his hospitality. A lookout tower affords him a point of vantage from which to study the habits of the flock, and occasionally to shoot down a menacing bird of prey, The picture was taken as the ducks rose from the lake.

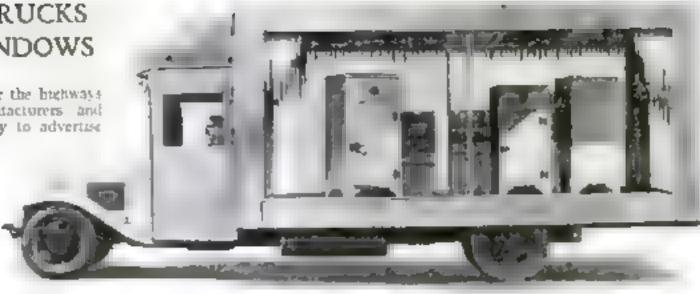


A vast cloud of wild ducks caught by photographer as they rate from a grivate sanctuary in Arkanasa

GLASS-SIDED TRUCKS REAL SHOW WINDOWS

By moving merchandise over the highways in glass-walled trucks, manufacturers and dealers have found a new way to advertise

their products. The vehicles serve as show windows on wheels and draw the eyes of passers-by to their contents, which are attractively displayed. In some cases they are used to make deliveries to customers, or to transport merchandisc between branch stores, while others are employed solely as traveling displays.



filese order on this work give a clear wiew of He contentambich are attract only attended like a show window

BUTTERFLY MAP OF WORLD AIDS FLYERS

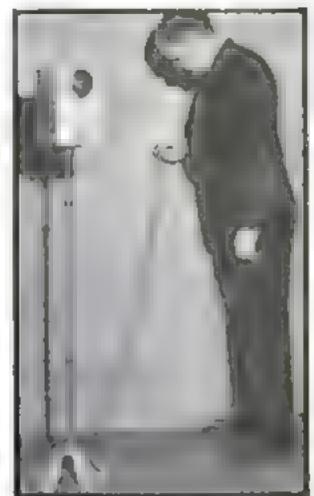
Balow, the butterfly map which correctly represent areas and disc use on earliace of earth. High rubber built at a spower and present flat would exemble the busterfly map

Drawing a butterfly by B. J. S. tect, to repupon a flat chemes do have wrest!

Drawing a world map in the shape of a butterily is the odd method purposed by B. J. S. Cahill, San Francisco architect, to represent the earth's true shape upon a flat surface. Newest of the many chemes devised by cartographers who have wrestled with this difficult problem,

it is declared especially useful in charting world weather conditions and the routes of long-d stance aviation thigh s be cause of its comparative lack of distortion. While common in a par show North America as about

for example, the butterfly map correctly portrays them as about of equal size. In one form of the new map prepared for aviation use, all straight lines drawn upon it are great circles of the globe



IN NEW HAND EXERCISER

By BENDING a strip of spring meral into a series of loods, and attaching a pair of leather grips to the ends, a British inventor has produced a simple hand exerciser for golfers, tennis players, and musicians. When the user squeezes and relaxes the fingers of the hand holding the device, as shown at right, the muscles are said to be strengthened.



SNAILS NOW GROWN ON GERMAN FARM



A snall farm not far from Berlin, Germany, lays claim to being the only place outside France where these land-going mollusks are raised for food. Bushels of the shell-covered creatures are shapped from this establishment to German and French markets. where they are considered a table delicacy. Because their wanderings cover an area surprisingly large, the snails on the German farm. are confined by miniature were fences like the one secu enclosing the field in the photograph at left.

PUBLIC ADDRESS SYSTEM USES WALL SOCKETS

When the transmitter of a new public address system is plugged into the nearest wall socket, as shown in the upper view, a standard radio receiver and laudspeaker connected to any other socket in the building will reproduce a speaker's voice. An amplifier within the microphone cabinet, abown in lower view, transmits the program over existing electric light wires, dispensing with trailing cables between microphone and loudspeaker.



VALVE SECT ON OF TEST TUBY ! - BON-SULPHIOL CORN HOLES.



This ample gas generator is useful in preparing small quantities of gas. It has a valve, as construct on diagram, upper jeft shows, that stops gas when flow as cut off

T IS surprising what exciting and mystifying experiments can be performed with a few cents worth of su. phur

Like oxygen, sulphur is a particularly active element. In fact, it combines with many substances so eagerly that intense light and best accompany the reactions.

At high temperatures, sulphur combines with metals to form sulphides. To demonstrate this, the amateur chemist can place a small quantity of sulphur in an ordinary tin can and beat it with an alcohol or gas flame until it burns. If a wad of steel wool then is pushed into the can, the sulphur immediately will combine with the iron to form iron sulphide. In reacting, the mass will glow and crianble like a miniature volcano.

Zinc shavings or clippings, pieces of copper window screen, aluminum brouse, and other metals thrown into burning sulphur will react in a nimitar way to form metallic sulphides The slag or sulphide that remains in each case should be removed from the can and placed in a labelled bottle for future use.

Mercury and sulphur can be made to combine amply by rubbing or grinding flowers of sulphur in a mortar with peveral drops of the liquid metal. Mercurie aulphode will re-

Zinc dust (finely divided zinc) and sulphur also will combine readily if the maxture is set off by an electric spark. The powder can be placed in the

lid of a Lin can connected to one side of a battery consisting of two or three dry cells arranged in series. The second wire from the battery should be thrust through the pile of aims and sulphur until it comes in contact with the can. By scratching the wire on the can, it can be made to spark pufficiently to set of the mixture. A brilliant flame will result. Although the experiment is otherwise barmless, the home chemist should keep his hands at a rafe distance from the flaming muxture

fron filings and sulphut can be made to combine without heat. Simply make a mixture of the two and rub it into a paste with water. In several bours, the mixture will become stone hard.

By taking advantage of the fact that tron and sulphur combine to form a black sulphide, the chemist can use sulphur to obrain a black finish on iron. First a

physical solution of sulphur in warm turpeasine should be made. This will furnish the sulphur in a convenient form for then to the surface of the from The tron objects then should be dipped nto the solution and finally held in the dames of a gas or alcohol humer. To optain an even lustrous coasing it may or necessary to repeat this dispung and heating process neveral times. When heating the turpentine to dissolve the sulphur, keep a square of asbestos board handy. It can be used to smother out the flames if the liquid nuddenly takes fire.

In its ability to form evil-smelling compounds, sulphur has few rivals. Most common of these compounds is hydrogen sulphide (a posionous gas), formed when a sulphide in brought in contact with an

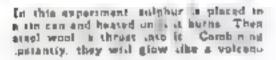
When small quantities of he gas are desired, the amateur can manufacture it with affety in the novel automatic gas generator shown. It consuts simply of a wide-mouthed bottle supplied with a cork which is fitted with a length of large tubing. A test tube with a broken bottom will serve the purpose meely. Fit the bottom of the tube with a perforated cork and place the solid reacting substance (from sulphide in the case of hydrogen sulphide gas) inside the tube. The upper end of the tube should be closed with a cork or rubber stopper fitted with an L-shaped piece of glass tubing

The lower end of the L-shaped exit tube should be closed and supplied with a small hole as shown. This can be done by heating the tube in a flame and allowing the end to melt and close over. The hole then can be prepared by holding the side of the tube in the flame until it is red hot and blowing into the other end of the tube to force the wall out. When the glass has thinned, pierce the hole, rebeat the tube, and finally roll the hot tube on a sheet of asbestos to smooth the edges and avoid the formation of a lip. This hole must be smooth, as it is to serve as a valve for the generator

When the tube is pushed down in the stopper exposing the bole, the acid in the bottle will rise in the test tube and react with the solid to form the gas. Pulling the tube up, thats the valve by allowing the cork to cover the hole. This will prevent the gas from escaping and cause it to force the acid below the level of the solid. The reaction then will cease.

Invisible Inks, and Pictures That Will Change Colors Most Mysteriously, Can Be Made with Ease in Your Own Laboratory

Below an uncolored picture pointed with a metalise solution, neveral of which are given in the test. When the picture is exposed to bydrogen surphide water, colors appear



In case of hydrogen sulphide, the neid can be one part of sulphurk or munatic diluted with three or four parts of water (by volume)

If hydrogen susphide gos is allowed to bubble through water, a weak acid known as hydrogen sulphide water or hydrosulphuric acid is formed. It should be stored in a well-stoppered bottle to preserve it to time, it will turn milky in appearance owing to the gradual precipitation of the free sulphur

Such a solution can be used as the basis of some interesting color experiments with metallic solutions. Added to copper sulphate, for instance, a black sulphate is formed. Mixed with tron solutions such as ferric ammonium sulphate, black from sulphide will be produced. Mercury solutions give a black precipitate of sulphide of mercury, animony, biamuth and tin solutions give orange, light brown and brownish-black precipitates respectively, while cadmium solutions produce yellow cadmium sulphide.

To produce the colored precipitates formed by the antimony, bismuth, and tin solutions, it will be necessary to add a drop or two of muriatic acid after mixing he crystals with water. This will cause them to dissolve to give a clear solution.

This color-forming characteristic of by drogen sulphide and metals can be used to perform an interesting and mystifying experiment. An uncolored picture or scene can be painted with the chemical solutions suggested above. When applied they will appear colorless but on exposure to a wad of cotton dipped in hydrogen sulphide water they will become mysteriously colored. For instance, the little girl's dress in the picture shown was painted with colorless antimony chloride solution. When the hydrogen-sulphide-soaked cotton was waited near the paper, however, it turned orange

from no acts can be given a black an ship dipping them in a so unsest of au phur and warm turpentine and then hesdang them in the gas flame.

A variation of the same reactions can be used in making invisible ink for secret writing. Writing penned with a lead acetate or a ferric ammonium sulphide solution will be invisible. It can be developed and made visible however, with hydrogen sulphade water

Strange as it may seem, small amounts of hydrogen sulphide and other sulphur compounds usually are present in the air in fact, it is their pres-

ence that causes articles of silver to become tarnished when left exposed. The tarnish in reality is a coating of silver sulphide

To prevent the formation of this coating, place lumps of campbor in close contact with the metal; in the drawer or cabinet where the silver is stored. The campbor will sublime on the silver and form a protective coating that will prevent the sulphurous air from reaching the metal.

Lead paints become discolored for the same reason. In this case, however the product that causes the discoloration is lead sulphide. However the fact that lead sulphide can be oxidized to lead sulphate which is white, makes it possible to treat discorored painted surfaces. A solution of hydrogen peroxide washed over the blackened paint, often will restore its color,

You can prove this experimentally by exposing a piece of white paper, dampened with lead acctate, to hydrogen sulphide gas or hydrogen sulphide water to form lead sulphide. Then swall the stained paper with some household perouide. The miscent oxygen from the perouide will bleach the color, changing the black test sulphide into white lead sulphide into white

Hydrogen sulphide gas can be made to react with bot lead peroxide to form white lead sul-

phate. The reaction is particularly interesting because it produces a brilliant light. The lead peroxide (brown exide of lead) should be placed loosely in a glass tube and the hydrogen sulphide gas passed through the tube. Heat the tube containing the lead peroxide. This will start the reaction which will containe until all of the lead peroxide is changed to lead sulphate.

In this, as in other experiments with hydrogen suiphide gas, the unused gas issuing from the open end of the reaction tube must be passed into a bottle containing sodium hydroxide solution. This will effectively absorb the surplus and prevent it from (Continued on page 109)



SUI PHURE

Useful Inventions FOR THE

DINING TABLE AND SHELVES IN ONE

When the set of shelves, shown at reft, in rocked over on its pivot, it becomes a during room table which can be moved on its own casters. She was are so arranged they remain horizontal in all positions to dishet are safe





When the box shows at right in copped it aurvin q c.gariste, The last one in the box, however a reto-ned as a warming the box is nearly amply It will hold about thirty elgaratics



out damage. They also make possible a change in type of legs if desired at versous times.

DETACHABLE





SHOPPING CART A recent longwatton in this country is the shopping cart illumented above. The shopper pushes the cart from counter to counter selecting her goods and finally checks it at the packaging department



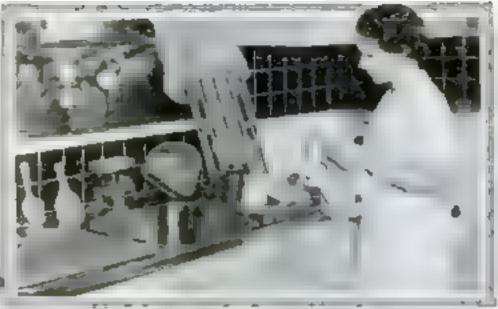
CREAM SEPARATOR. It is easy to separate the cream from the milk in a bottle with this device. The short end of the tobe is inserted in the rabber cap which is placed over bottle. Pressure forces the cream out



RUBBER FURNITURE CUSHIONS. Whipped into a froth, rubber is poured into wafficilite molds and shaped to fit the jamide of furniture cosbions. Said to be insuc)-proof

Household







CAN'T STICK

tests ghad

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a vec er cestage

a vec er cestage

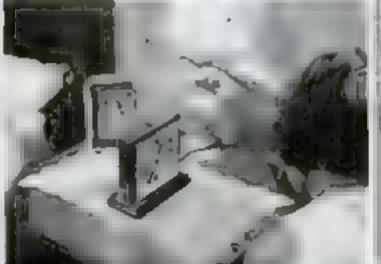
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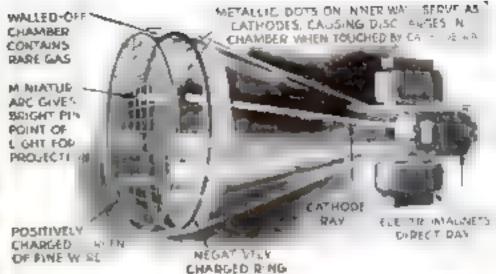
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Left, Gilbert P. Schmidling, lawester of new cashade-ray tobe for televition, in some with two of the experimental models bush to test his draign-Above, diagram showing principle of new system

Cross-up of combination window in model of new tuber by a to contrast the brightness of projected image of the old and new types

Myriad Dots of Light Give New Television

'RIADS of tany twinking electric ares build up a picture on a screen, in a new type of television receiver now under experimental development for home and theater use. Described for the first time in this magazine, it sime to produce an image brilliant enough to be projected upon a acreen of virtually unlimited dimensions, for parlor or public entertainment. Moreover, this is to be done without the complication of the moving parts that characterise most present-day television sets. The secret of the new receiver, developed in an effort to provide practical television for the man in the street, is a cathode-ray tube that departs boldly from conventional lines.

When a television broadcast transmitter dissects the image of a studio scene and translates its high lights and shadows into a rapid-fire series of radio impulses, the problem at the receiving end is to reconvert these impulses into light and put them together again in the form of a picture. Of the many devices contrived to do this. the cathode-ray tube has always partic talarly attracted experimenters because of its freedom from moving parts. In the standard (unnel-shaped form of this tube, a speeding beam of electrons constantly sweeps a circular window at the wide end, which is coated with fluorescent chemicals. Wherever the beam strikes the window the chemicals glow. By directing the beam magnetically and controlling its intensity by means of incoming radio signals from the distant transmitter it is made to redraw the studio scene upon the glass. wall of the tube. One drawback, however has limited the usefulness of this system. The resulting image is too dim to be magnified to an appreciable size, and must therefore be viewed directly in a window a few inches in diameter

Seeking a cathode-ray tube with an image brilliant enough for projection, Galbert T. Schmidling, New York radio experimenter, tried out thousands of fluorescent materials without avail. His search yielded interesting by-products, including the coid lamp described last month in this magazine, but revealed nothing that combined, to his satisfaction, the two vital qualities of a television screen, high luminosity, and quick fade-out. Then he solved his problem by the remarkable expedient of discarding the fluorescent screen altogether. What he substituted in its place makes his cathode-ray tube one of the strangest of radio creations

In design the new type resembles a standard cathode-ray tube minus its fluorescent acreen, with a cylindrical extension of glass added at the large end. As shown in the accompanying diagram, this extension is a walled-off chamber containing three types of electrodes—a screen

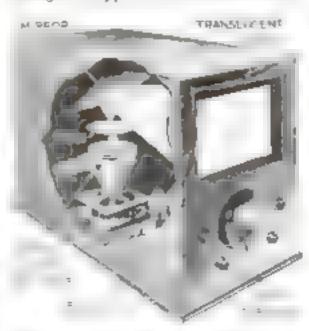


Diagram shows emistraction of proposed home terevision set, which produces a large image

of one wire, a circular ring, and a pattern of thousands of metallic dots printed on the inner wall. The chamber is filled with a rare gas such as peon.

When the moving cathode ray, or electron beam, passes over one of the metallic dots, it acts like a trigger to set off an electric ducharge between electrodes in the auxiliary chamber, The luminous discharge resembles that of the neon crater lamps used in other television systems. Thus pen-points of light, apposite the dots that receive the full intensity of the moving ray, merge to form a bulliant image that with a suitable lens can be thrown on a screen. The wire-screen electrode between the original image and the observer does not obstruct his view of the picture, since the fine wires are thrown out of focus and rendered invisible in projection.

her home television, a tube with a window about four inches in diameter would be used. Its pictures would be thrown from the rear upon a translucent screen approximately eighteen inches in diameter. According to Schmidling, the images would be bright enough for on-lookers to see them without the inconventence of turning off the living-room lights. Larger tubes would throw television pictures on theater screens.

As early as 1927, Schmidling told Popular Science Monthly, he tested his invention with a crude model, building another of more elaborate design the following year. These two models, illustrated at left and right respectively in the photograph at the top of this page demonstrated to his satisfaction that his theory was sound. Improved tubes developed in more recent tests, he believes, have paved the way for commercial application of the new system.

New Battery for Two-Volt Set

REVOLUTIONARY METHOD OF CONSTRUCTION CUTS COST TO ONE CENT AN HOUR

hours at less than one cen an hour, the battery, shown in the illustrations at right forms a new type of filament supply for two-volt receivers.

Resembling a large size B battery in outward appearance, this fifteen-poundry unit is rigidly constructed and supplied in a sturdy case. Embodying what the manufacturers term a revolutionary method of construction, this recently developed battery is said to operate with a minimum of current drain.

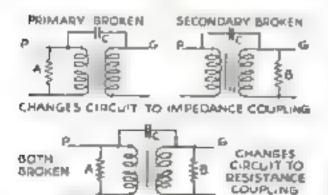
Although primarily a three-volt baltery, it serves as a two-volt source through the use of a novel reastor resembling a miniature voltage divider. The strip, connected to the positive terminal of the battery, is a wire-wound resistor having four easily operated clays spaced at intervals along its length When the battery is first put into use the clip at the extreme end is user The other clips are used in succession as the voltage of the battery drops In this way, it is possible to maintain the supply voltage at exactly two volts throughout the life of the battery.

Emergency Repair of Audio Transformer

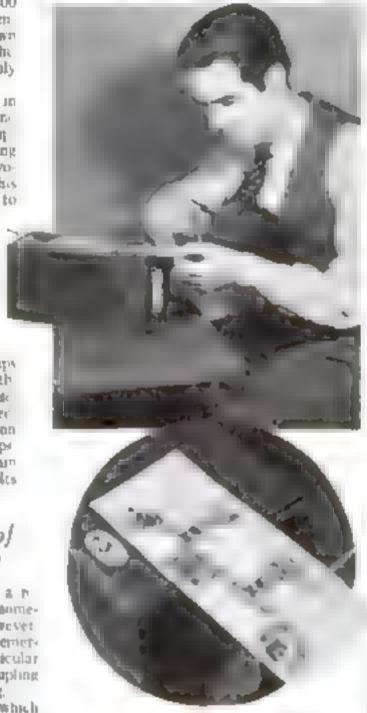
WHEN an audio transformer in a receiver goes dead, it is difficult sometimes to obtain a replacement. However the radio handy man can make an emergency repair by changing that particular amplifier stage from transformer coupling to impedance or resistance coupling.

First of all, you must determine which winding of the transformer is at fault. This can be done by making a simple continuity test with a pair of earphones and a small battery (C battery will do). Connect the phones and battery in seven wire the free terminal of the battery to one side of the winding to be tested, and touch the unconnected phone tip to the other side of the same winding. If the winding is continuous and not broken, you will hear a sharp click in the phones everytime the contact is made or broken.

If you find that the primary winding, for example, is broken, the receiver can be made to operate by connecting a 100.



D agram shows how to make an emergency repair what the audia transformer fails to work



At top, connecting up the new type A harrery In nincle, alone-up of battery's resistance strip

000 ohm resistor (A) across the winding and a .01 microfarad condenser (C) across the plate (P) and grid (G) terminals of the transformer. If the secondary proves to be at fault, connect a 500,000 ohm resistor (B) across the secondary, also shorting the plate and grid terminals with the .01 microfatad condenser (C). In either case, the addition of the condenser and resistor will convert the original transformer-coupled stage into an impedance-coupled circuit.

Although the chances are against it you may find that both windings on the transformer are broken. In this case connect the resistors specified (A and B) across their respective windings and short the grid and plate terminals with the condenser (C). This will change the circuit into a resistance-coupled stage

Incidentally, the resistors can be smaller than those specified, but in any case the secondary resistor should be at least four times larger than the resistor shorting the primary. Also, the primary resistor should not be smaller than 50,000 ohms.

Naturally, a repair of this type is a makeshift at best but where a stigh decrease in volume will not effect the reception, it forms an excellent emergracy repair—L. K.

Pilot Lights Detect Transmitter Trouble

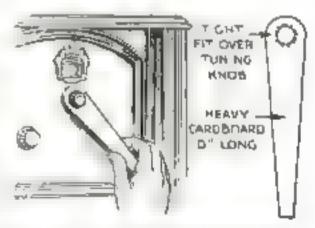
BY PLACING a small coil of wire in series with a regular one-and one-half-volt flash-light lamp, you can provide your short-wave transmitter with a simple pilot light. The coil containing two or three turns of wire can be placed close to the plate end of an oscillator or amplifier circuit When the power is on, the wire will pack up enough current to light the bulb and tell you that the circuit is operating. If desired, a phot light of this type can be placed in each stage of a multi-stage transmitter. The bulbs can be mounted behind lensshaped pieces of red glass inserted in the face of the transmitter panel above the controls,-G. D. T.

Novel Short-Wave Tuning Lever

BECAUSE they lack high-ratio tuning duals, many of the new radios built to cover the short-wave bands present a dificult problem in tuning. With the small knobs used, it is an easy matter to pass completely over the desired station without hearing it.

A solution to this problem, however is round in the novel tuning lever shown in he illustration below. It will improve the tuning accuracy of a small knob more than sixteen times by increasing the effective diameter of the knob.

Cardboard, one sixteenth of an inch thick, will serve as su, at a material for the lever. The hole to receive the knob should be made one eighth of an inch smaller than the actual diameter of the knob. Then, a series of one-sixteenth-inch cuts should be made radially around the opening and the flaps formed should be bent back. The purpose of these flaps is to provide the tension required to hold the lever family on the knob.—A. W. A.



Tuning layer, easily lastelled, that increases tuning accoracy of set lacking high-ratio disk

hort-Wave

LEWIS WINNER tells how to

HERE is no need to give up your short-wave hobby when you are away from home. The midget, eight pound receiver illustrated operates on direct as well as a ternating current and will give you clear, loudspeaker reception wherever \$10 volts are available

In appearance, the outfit resembles the tiny broadcast sets that have gained widespread popularity during the last year. In fact, it was designed to fit into a regular midget cabinet that was obtained for next to nothing from a dealer in second-hand radios

The circuit is simplicity itself. It consists of one stage of radio-frequency amphication, a regenerative detector, and two stages of resistance-coupled amphication fed by a novel A.C.-D.C. power supply. The tubes used are types 2525, '43, '37, '77, and '78.

Complete, cabinet, tubes, and all, the set should not cost you much over twenty deliars, provided, of course, you wind the coils yourself. Because of the A.C.-D.C. power supply and resistance-coupled amplifier used, no transformers are needed. Also, inexpensive condensers can be used without reducing the efficiency to any great extent

Like the commercial compact broadcast receivers, this short-wave set also is mounted on a ministure channel-shaped chassis. The midget dynamic speaker, having a five-inch diameter cone, is mounted in a groove or slot in the front of the chassis and is held in place with one screw passed through the bottom mounting hole in the outer rim and two through the chassis. Two rectangles of sheet metal spot-welded or bolted to the front of the chassis at both ends serve to support the two tuning condensers (Cr and Ca).

Seven wafer sockets are arranged on the top face of the chasses as shown in the photograph. Two, a four-proper and a sta-prong are for the pluggen cots. These are plured at the extreme ends, at the rear, so the coils can be changed easily. The other sockets required are a five-prong for the '37 tube and four of the six-prong type for the 2525, the '43 the '77, and the '78. Also mounted on the top of the chasses are the filter choke A and the filterent resistor Rs.

Although the circuit was designed primarily to cover the short-wave bands from fifteen to 200 meters with four sets of plug-in coils, the range can be extended satisfactorily to cover the broadcast band (200 to 550 meters) by using an additional broadcast coil. This coil is designated as number five in the winding table. However, because of its fundamental design, the circuit may prove less selective

on the broadcast band than it is on the shorter

In studying the circuit diagram you will note that various connections are indicated as bring made to ground. In every case, this denotes a chassis connection. These can be soldered directly to the chassis or to a brass soldering strip bolted to the made of the chassis.

Blueprints Ready

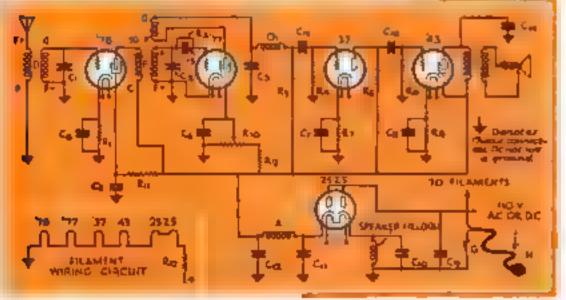
To assist readers in building this compact electric set, on easily followed blueprint has been prepared. It can be obtained by sending twenty-five cents to the Popular Science Bineprint Service Department, 181 Fourth Assins, New York, N. Y. for Blueprint No. 223





Front view of the ports





Wiring diagram of circuit, the specifications of which mu gives to table on opposite page. Note, the filament wiring is shown in diagram in the lower left hand corner

Receiver TO TAKE WITH YOU ON TRIPS

build this compact radio set

No actual connection to the ground should be made. The circuit requires only a long (5 to 100 feet), well-insulated antenna. If there is any doubt about the insulation of the antenna, place a .0001 microtarad fixed condenser in the antenna lead close to the set. In fact, this is a wise precaution even if the antenna is well insulated as it will protect the set should the antenna become

accidentally grounded

In changing the circuit for reception of the various hands, a set of two plug-in coils is required for each band. One coil, having a four-prong base, is the antenna coil while the other, fitted with a six-prong base, is the detector coil. The antenna coils have only two windings, a primary and a secondary, but the detector coils have three, a primary, a secondary, and a tickler. How these are placed on the ribbed coil forms is shown in the drawings. In the case of the short-wave detector coil, the primary is interwound with the secondary. On the broadcast detector coil, however, where the wire of the secondary is not spaced, it can be wound over the secondary.

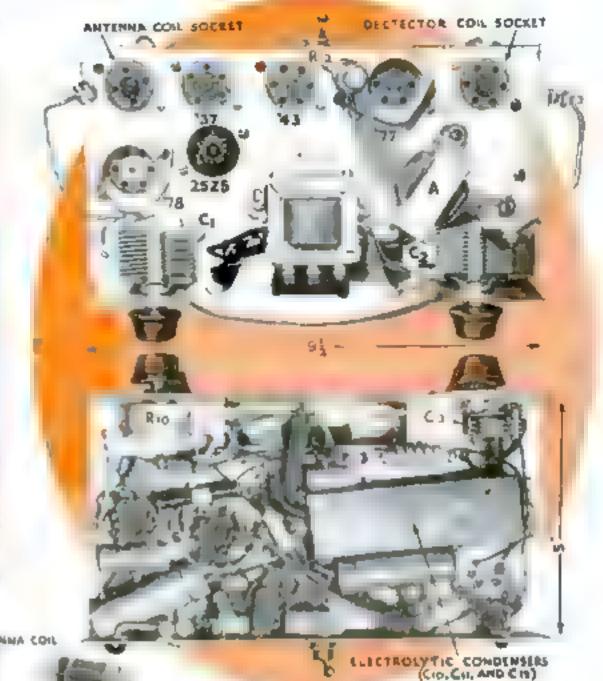
Although these coil sets can be purchased ready for use, you will save money by buying only the ribbed forms and winding them with enameled wire according to the specifications given in the box on this page (below). Be sure when making the connections to the coil base prongs that you follow the exact arrangement shown so they will

agree with the socket connections.

Because of the amount of drilling necessary, it

· Suicitati

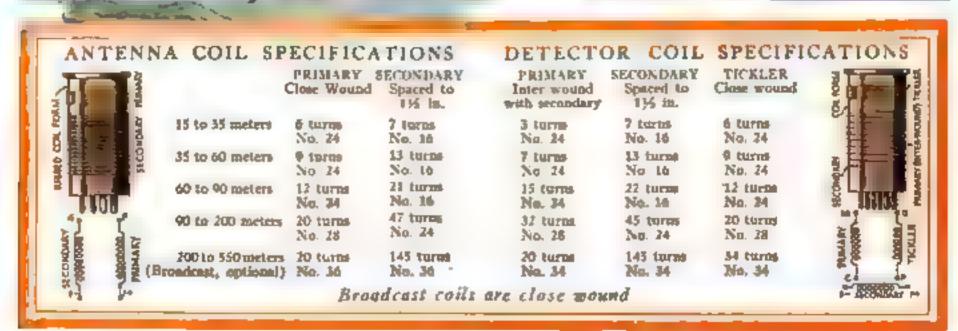
POWIE COID



View at the top shows the layout of eachers on chan-

will pay the amateur to buy his chasts ready-made from a dealer in radio parts who is equipped to do the work reasonably

When laying out the chassis, allow for the fact that the '77 and '78 must be fitted with tube shields, bases, and caps. Two boles should be supplied at the rear of the chassis—one for the power cord and the other for the antenna lead. The power switch also is mounted at the (Continued on page 114)



Hunting Your Car's Caster

By MARTIN BUNN

Gus Gives a Practical Lesson in Adjusting the Front Wheels

t S WILSON S annual visit to his upstate relatives had a way of developing into a businan's houday

On this particular trip his hopes for a workless vacation were shattered the second morning of his stay. This time it was Bal, has eldest nephew, who upset his plant for a week of rest

"Uncle Gus," the young man began timidly as the gray-haired auto mechanic propped his morning paper against the sugar bowl and leisurely poured himself a second cup of coffee, "will you show me how to check the steering gear on my car while you're bere?"

"What seems to be wrong?" asked Gus goodnaturedly

"The car keeps running to the right," explained bill. "I have to wrestle with the steering wheel to keep it on the road"

A great was Gue's only answer as he followed his nephew to the front curb where the car was packed.

"First of al. we'll have to find a good place to work," said Gus after a

hasty inspection. "How about running the front wheels onto the driveway notside your garage? While I move the car around there, you go to your Dad's workshop and see if you can hunt up a couple of lengths of wood lathing, a hammer, a saw, some nails, and a large steel square. And say if you can find one of those adjustable spirit levels bring that along too."

Gus finished parking the car fust as Bill, his arms laden, emerged from the

cellar door

"What are you going to do with all this stuff, Uncle Gus?" asked Bill as be piled the tools and lumber on the car's running board. "All I want to know is how to check the steering gear."

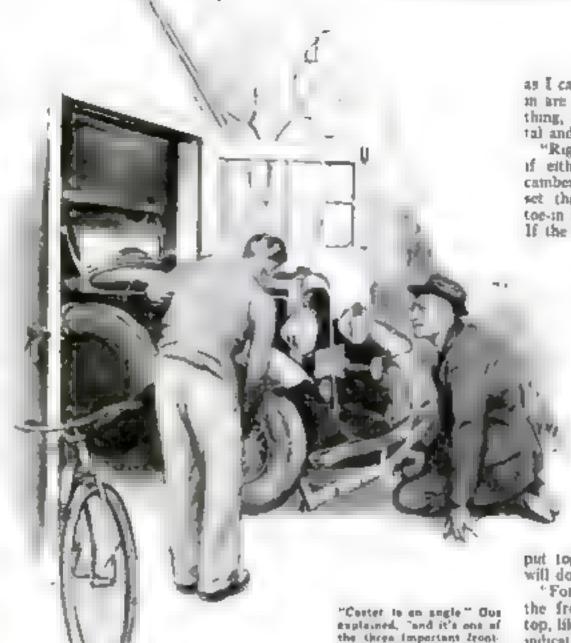
"I don't think the steering gear has much to do with your trouble," replied Gus as he picked up the two long stocks and sighted along the first one and then the other. "Sounds like unequal caster."

"Unequal what?" asked Ball "Caster repeated Gus. "Don't you

"No relation to the oil is ft." grinned

Bill.

Gus shook his head. "Nope, it's an angle and it's one of three important front-wheel adjustments. There's camber,



toe-in, and caster "

The puzzled look on Bill's face told Gus that the subject seeded some tall

wheel ad ustmente There a

combet too on, and caster"

explaining

"Here, take a look at this," and Gus as he wheeled out a bicycle that had been leaning against the garage wall. "Do you notice how the steering pivot for that front wheel is back of the wheel's center Well, that's caster. It's just like the arrangement of the casters on furniture legs. The front wheels of an automobile are pivoted in just the same way. The king pin on each wheel is tilted by the axis to give the caster angle.

"Now, if this beycle wheel is tilted a little off the vertical," Gus continued as he held the bocycle at an angle, "that illustrates camber. The front wheels of a car are tilted just like that. They're mounted to be closer together at the bottom than they are at the top.

"As for toe-in, that s just what you'd expect from the name," continued Gus. "The front wheels are pigeon-toed, their front edges are closer together than their tear edges."

"How the dickens can two wheels be like that all at once? Seems like they'd get all mixed up," argued Bill, "As far as I can see, camber and toem are pretty much the same thing, except one is horizontal and the other is vertical."

"Right," agreed Gus, "and if either the caster or the camber are wrong they'll upset the toe-in. That's why toe-in is a check on them all If the toe-in measures O. K.,

you can be pretty sure that the comber and caster are right."

"Sounds like an awful lot of measuring to me," observed Bil. How would you check all those angles?"

"Well, the best way is to use requiar measuring instruments that are made for the work Ail good repair shops and service stations have them Of course, in a case ake this, you can

put together some tools that will do a good enough job

"For instance, camber tilts the front wheels out at the top, like this," Gus explained, indicating the angle with his hands, "Well, we can check that by placing a large steel aquare flush against the hub

and measuring the distances between the nm and the vertical edge of the square at the top and at the bottom of the wheel. If the (Continued on page 115)

WHAT AILED STEFFINS' CARP

Announcing the Prize Il Inner

IN the January been of POPULAR SCIENCE MONTHLY, Martin Burn described the troubles Pred Steffine, one of Gus Wilson's customers, was having with ids car. A prize of twenty-five dollars was offered for the best letter explaining the difficulty and telling how it could be remedied.

Many readers submitted solutions, a large number stating correctly that a worn timing chain or a slipping fiber timing goer was the cause of the crouble. In the opinion of the judges, Richard P. Lawson, Detroit, Mich., wrote the best letter diagnosing the trouble and describing the semedy and Mr. Lawson was awarded the prize.

BETTER SHOP METHODS: IDEAS AND PROJECTS FOR THE HANDY MAN

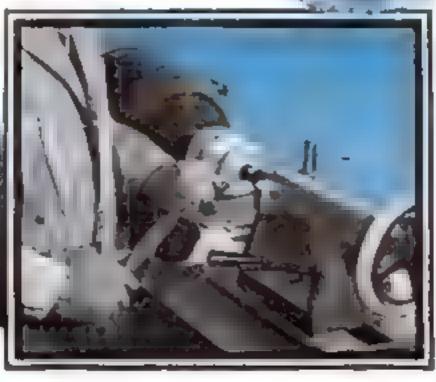


MODEL MAKING : HOME WORKSHOP CHEMISTRY : THE SHIPSHAPE HOME

Artificial Marble Novelties

TURNED IN LATHE

LIKE WOOD



Two decorative flewerpots that closely exemble markle but are rearly made from an incorposeive planter mixture

A New Type
of Craftwork
That Is Easy
to Do and Costs
Next to Nothing
for Materials
By
E.G.Livingston

Assistant Professor of Industrial Arts, Jowa State College

really new to make in your home workshop or at school, you should experiment with turning artificial marble. This fuscinating handicraft has many advantages. An important one is that the material is quite inexpensive and is obtainable everywhere. You can have the fun of making a number of thungs at the cost of only a few cents. In spite of their low cost, however, the finished articles are useful, novel, and beautiful. They never fail to elicit the admiration of all who see them.

Even the most inexperienced amateur can achieve success with the more simple forms, yet the most skiliful worker will find a challenge to his liking. The possibilities in both design and craftmanship are practically unlimited. If you have a lathe and a few common hand tools, you need no other equipment. Finally, but not of least importance, the articles have sales value. Any man of skillful and ingeneus bent may turn his pastime into ready pocket money.

If you would like to try your hand at making some of the attractive pieces illustrated, the first step is to go to any lumber dealer or building supplies firm and purchase about ten pounds of Keene's cement. The superfine grade is best, but

The special coment is mixed with water for such a way as not to stir to too much air. Then dry imperior plaster colors are added to produce a pattern that looks like marble

COLORS GIVE

MARBLE REPECT



A few examples of art ficial marble work. The book ends were turned in one piece, then put in half with a hand saw. The organize builder has a copper in ng around which the marble misture was cast before any futning was done. Each piece is beautifully colored

the regular grade in very nearly as good and is less expensive. Ten pounds should cost about twenty-five cents. At the same place buy about a quarter of a pound each of two or more imeproof plaster colors. These are mineral colors in powder form and may be had in a variety of bues. Do not buy coment

It is wise to select a simple piece for your first attempt. A pin or paper-clip

tray or an ash tray is statable

To make a furm in which to cast the coment, out a circle about 31/2 in. in diameter from any scrap wood from 34 to 14 in in thickness. Attach it to a lather faceplate, using screws that are long enough to extend about ½ in, through the wood for the purpose of holding the rement. Place the faceplate on the lathe and true up the wood. The wood should now be given two or three costs of lacquer to make it impervious to moisture It you do not have lacquer, however, use hot parathin, paint, vatuish, oil, or shellac-

The cast for the pin tray need not be more than I in, thick, Cut a piece of light galvarized from long enough to enearcle the wooden disk with about a 35-in. lap. The width thould be I in plus the thickness of the wooden base. Attach this to the periphery of the disk with three roundhead acrews to form a shallow cup. Lacking galvanized from, you may use tin or even cardboard

MELT some paraffin and add an equal amount of ketosene. When this is cool it will be about the consistency of paste shoe polish. Coat the inside of the form with this "dope." Of course, linseed oll or machine oil will serve the same pur-

For runing the Keene's cement, you will need a shallow granite pan or a mixing bowl, a large granite or a heavily tinned apoon, and a cup for water. Putty knives of even old case knives are convenient for handling the colors. The cement needed to fill the form and the required amount of water are easily determined by a little experimenting. Roughly the amount of cement by volume will be a quarter more than the amount of dry cement required to fill the form, and the amount of water will be about one third of the volume of cement

Place the cement in the pan, add the water, and mix it thoroughly for several minutes. Do the mixing quietly, keeping the spuon submerged in order to avoid stifting in too much air. Do not heat it The consistency of the batch should be quite quakey, but hardly thin enough to pour

To add the colors, simply take a little on the end of a putty knife and cut it mto part of the batch. Take care that no lumps of dry color are unbroken. A different color may then be mured into used effect is obtained by stirring these rolored areas together just a little or by mixing them as you fill the form, Many attractive color combinations may be worked out with a little experimenting

IN THE process of filling the form, stop occasionally and bang it rather hard several times upon the beach top to jar out the air bubbles. When the form is full, cover the top with paper or a damp cloth to prevent excessive drying of the exposed surface. Put the cast away to set for from enthreen to twenty-four hours. It should be firm, but should cut

easily when ready to turn.

Select a simple design for the pin tray and make a full-size drawing of it. Remove the metal or cardboard form from around the cast, and screw the faceplate on the lathe. Work as you do with wood. using the same tools or improvising tools from scrap steel or files. If the cement is at the right stage, not too hard, it can be cut with surprising ease and will not dull the tools as quickly as does wood The cement cuts smoothly at a slow speed of about 1,200 a.p at , and at that speed it is not apt to fly off the faceplate.

When the cutting is done, the piece should be removed from the faceplate and allowed to dry for another twenty-four hours. It is then polished with No. 6, D. or 8/0 sandpaper. If you aftempt to sand it while damp, the colors will smear. If you can get No. 7 0 wet-or-dry (waterproof) sandpaper, it is better to polish

Special construction hits for making thip models and furniture will be found listed on pages 96 and 97 the Keene's cement under water in a lavatory or large pan. Carborundum stones of fine grain may be used for polishing Hai sterioces under water.

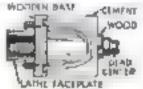
By exercising ingenuity in building the forms, you may make larger articles such as candy or nut dishes, powder or jewelry boxes, cigarette containers, flowerpots, bulb trays, candlesticks, and table lamps. beveral such articles and the forms used in their construction are adustrated in this arricle

The little hanging ivy pot was made over a pyrex custard cup which had the run set very tightly in a groove in the wooden base as shown in one of the photographs and a drawing. It is necessary to turn only the outside. When dry, the cement cup slips readily from the glass. Such a device makes it possible to save a great deal of time and a certain amoun. of materia.

Flowerpots made of Keene's cement have one bad feature. They are not water peoof Water not only seeps through them, but it causes a rough precipitate to gather on the surface. If you wish to set the plant directly in the pot, it should first be coated on the inside with liquid rubber. To avoid making a hole in the bottom of the pot, I place a faue bottom of galvanised from about 1/4 in from



A tray form Inner and nater forms for a eraal try pot, and. right, how the very ms was set up in a larke to be surned



the bottom. The false bottom is punched full of boles, and extending from it there is a small tube reaching above the surface of the dift. This serves to carry water and air to the roots and makes for a generally healthy plant condition.

The form for the cigarette holder was prepared in a numilar way. A small cylunder, closed at one end, was made of copper and used as an inside form like the custard cup except that it was not removed, but became a copper lining in

the cigarette jar

The book ends were turned as one piece and sawed in two with a hand saw while still soft. The resulting rough surfaces were ground down with a sharpening stone under water. They were sanded again with very fine poper when thoroughly dry

By the simple expedient of making a form 4 or 5 in, deep, several ash trays or pm trays may be made from one casting. They are lurned one at a time and cut off. The grooves for eigarettes may be put in the rim of the ash trays with a gouge or a round file

Other ideas will suggest themselves to you as you progress with this work.

Earth-to-Mars Rocket Plane

By Donald W. Clark

NTERPLANETARY rocket planes, although actually far in the future, are now familiar to everyone because of constant reference to them in radio and comic-strip adventure sturies. No one knows what these strange asscraft will look like, but there is no reason why the model maker should not delve into the future a bit on his own account

The rocket-plane design liliustrated is, of course, purely imaginary, it would be controlled by the tall fins by the wings, which could be tilted together or separately, and by two small movable rocket tubes at the front end

This model is made up of twenty-two simple ports, glued and pinned together. The body can be carved to shape with a knife, if no lathe is available, and smoothed with sandpaper. Saw two slots in the rear end to take the tail fies, and three long slots at the front end, as shown, to take the stabilizing fins, which should be glued on. Pin the wings to these and glue them to the body. Fasten the propulsion tubes with 1/16 in, diameter wire pins and glue. Outline the door

with the point of a knife. Make cardboard templates for cutting metal parts.

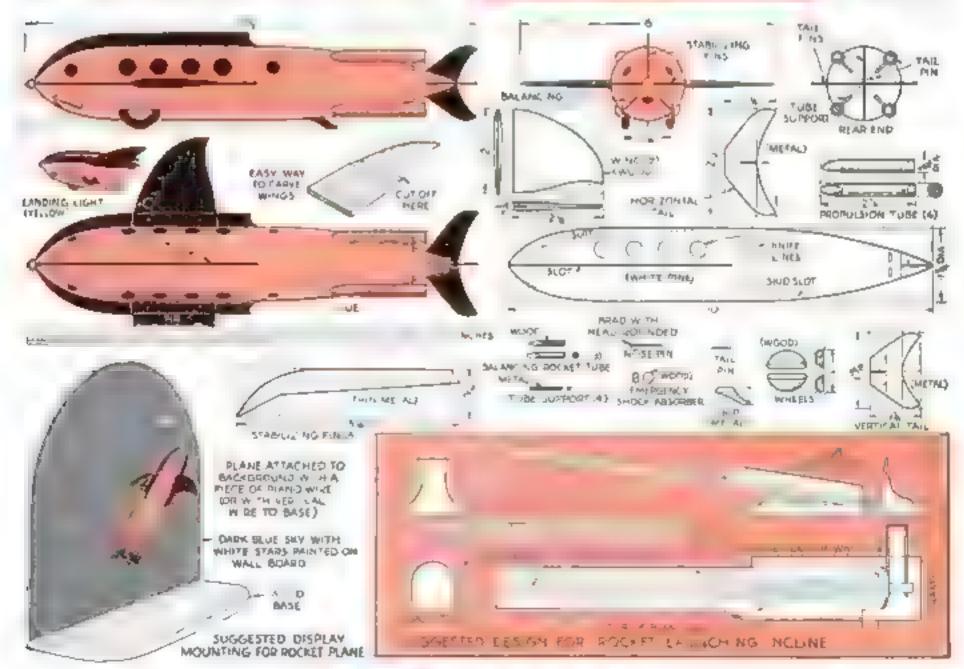
Give the complete ship a coat of flat white paint. Next paint the body, propulsion tubes, where, shock absorber, and balancing rockets red; and the wings, stabilizing fins, tail fins, windows, tires, skid, and rear ends of tubes, black

The mode will look well if mounted on the suggested launching incline. Better still, a decorative background can be made from wall board painted blue or half a

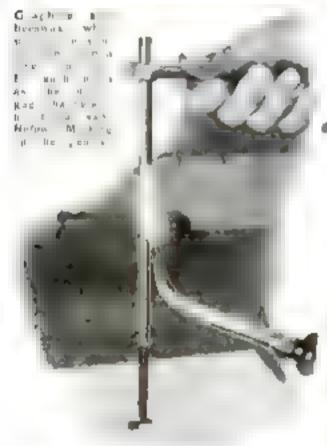
sheet of dark blue show-card board. Faint some light brue dots on it and one yellow rircle to represent the moon, and, if desired, another circle in an upper corner to stand for Mars. In front of this background, place the ship as shown.



Printed racket piece mode and a photograph of the parts before assembly if decay the model can be lettered Starocket—
Barth Mara Line*



Side, top, and from views the reer and details of the body, wings, tail units, tubes, and other parts, and two methods of mounting the model

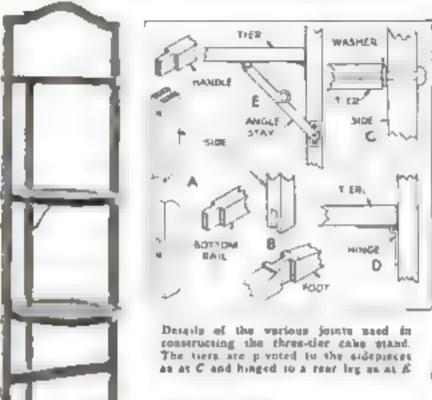


GREASELESS LUBRICANT USED LIKE PENCIL

You will find many uses around the home, shop, and garage for a lubricating pencil made of finely powdered graphite and beeswax. A thin coating of the graphite-carrying was rubbed on the latches of automobile doors will make them work amouthly yet will not come off on clothing. For lubricating the mitergage channels in circular saw tables, for waxing nails so that they can be driven more easily, and for hundreds of other jobs, the pencil will be found valuable

Obtain some beeswax and about on count volume of very fine (impalpable) graphite. Melt the wax in an old can and ster in the graphite. Pour the wax into n metal tube of from 1/4 to 3/2 in. Inside diameter the lower end of which should be plagged. After the mixture has solidified, heat the tube gently with a torch or gas flame until the wax pencil slides out but first remove the plug in the lower end of the tube to prevent suction. A layer or two of paper gived around the pench makes it easier to hold. The graphite is the lubricating medium. The purpose of the wax is nothing more than to serve as a carner - John C. Workley

LIGHT FOLDING CAKE STAND EASILY CARRIED AROUND



The cake stand opened for use Note the rulecount aray (10th the middle tter on the rear leg-

ERE is an extremely useful and attractive piece of furniture that any amateur craftsman can make. The charge of wood will be largely industried by the other furniture in the room and is, therefore, entirely a personal matter. The parts required (finished suces) are two uprights 1/4 by 1/4 by 54 in., one top rail or handle 12 by 25% by 11 in., one but-tom rail 14 by 14 by 11 in., two feet 14 by 21/2 by 9 in., one back stay to by a by 28 in., and three tiers 54 by 91, by

How the handle and bottom rail are joined to the sidesieces is shown in the drawings at A The first job will be to construct this part of the stand. Next make the joints for the two sides and feet as shown at B. When this has been conspleted, the bandle and two feet should be shaped, and this part of the job cleaned up and glued together

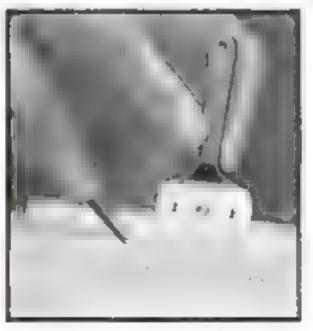
The three tiers should now be made and prvoted by means of a roundheaded screw as shown at C. This is free to turn easily in the sidepiece, but is screwed tightly into the edge of the tier A washer should be inserted between the two

To prevent the plates or dishes from al ding off, the center of the tiers should he recessed. This can be done on a lathe m a very few minutes or, if a rathe is not available, the recess may be cut out with a router If preferred, instead of recessing the middle, a strip of molding can be fixed around the edges

In order to operate all the three tiers together, they are hinged to a wooden stay, this also forms an extra leg when the cake stand in in use, thus giving addenrigidity. The position of the hinge is shown at D. A brass angle lid stay should be acrewed to the underneath side of the center ther and on the side of the wooden stay at at E. This keeps the three tiers rigid and prevents them tipping up when

Finally clean up and finult the cake stand by whatever method you prefer, An excellent way is to use a water stain, paste wood filler If required, and several thin coats of she lac. One of the new wasprocess finishes is even simpler-two costs of a special flat finish and one of paste WAR.—RAYMOND S. FORBES

CONVENIENT HANDLE FOR STEEL SCALE



A TEN-CENT holder for old cazor blades forms a convenient handle for the light steel scales used by mechanics for laying out and measuring small work, It can be fastened securely to the rule without macrang or bending it, and with it the scale is easily laid against the work for measuring and scribing. It also makes the scale easy to pick up when laid on the bench or other surfaces.-F W B.

MODEL ANCHOR CHAINS

ANCHOR chains for ship models can be made from copper wire of an appropriate size. Bend a number of rings around a match stick or other form, fit them together, and hold the chain over a burning match to color .- DALE W BRAHAM

THE HOMEWORKSHOP GUILD MOVES FAST

Latest News from National Headquarters
Many More Clubs Formed



Hardware Dealers Help
Recent Club Activities

THE new home workshop club movement gains momentum, club after club is reporting its organization in the head quarters of the Na iona. Homeworkshop Gatid in Rockford, Ilia, and applying for a local charter A list of the new Gubs and their othicers appears at the end of this article. They are distributed across the continent from New York to the State of Washington and from Florida to the Great Lakes.

The growth of the Guild and the enthusiasm with which I has been halled by amateur craftsmen everywhere are not according because it offers something that never before existed in the home workshop held—an opportunity for all those interested in making things to enjoy real conperation and compensonship in their hobbies. The purpose of the Guild is solely to promote the according to all varieties of what may be called "homecraft" It has nothing to seit in fact it is strictly noncommercial. Its national officers and directors are serving without pay and it is sponsored by an advisory



Professor Colors P Blass Dean of his dies of businessure Ven Luck University

Professor Code A Bowman Don't the known take trial Education Sout to me Memorial II is

Harvey Wiley Corbett to Am J. Nov. Land City

Dr. Hugh S. Cumming Surpose west build Study Lubia II alth Service

May Gen Benj D Foulist
Cha of the tre Coops I N drone

Capt F Armitage McCann Found of May Hodel Maker to ab Dr Francis G Pease

Frank A. Vanderlip
Banker and Publicity, New York

Tops made by Rockford Hometraft Club and, laft to right, Levers T Ryder president, Robert Horner, treasurer and Frenk Burrect. One ge Lust g. and Varn Promise, members of the code top committee

council of men of national prominence in various fields.

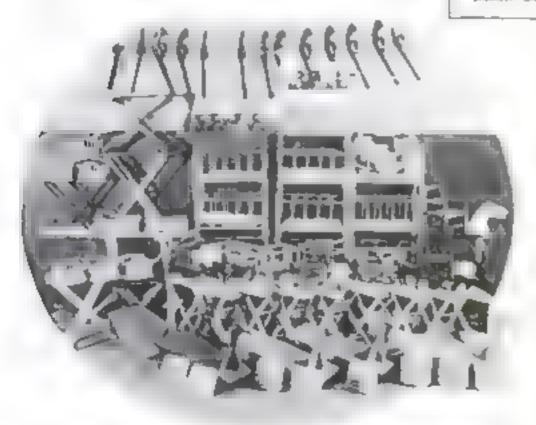
The Guile i incalculable value to homecrafters her in just this. It provides the expersence the intermution, and the substantial support hecessary to insure the success of any local home workshop club formed unter its auspices and conducted according to its saggestions. Just how a does this. is exponented fally in b erature which anyone may obtain without obligation by filling out the coupon at the end of this article. To regularly organized clubs, the Guld also sends monthly bulletins, and the secretary of each club receives a

subscription to Popular Science Monthly, the official magazine of the Guild. Other services also are provided.

Those clubs already formed have received their secord and third monthly bulletins. The third bulletin and certain others to follow are supplemented by special woodworking plan sheets with drawings and instructions. These are intended for the club library, but the sheets have been printed on tracing paper so that they can be blueprinted by the club for the individual use of any members who wish to make the projects described.

A survey is being made to find speakers and demonstrators for local clubs. Every manufacturer and large distributor in the bome workshop field has been asked to cooperate, in addition to those who have already voluntarily offered to help, and the resulting information will be tabulated by the speakers' bureau of the Guild and made available in the form of buileting for the use of all local clubs.

Another campaign the Guild is conducting is among hardware dealers. It has taken steps to place full information about its purposes and activities in the hands of practically all the hardware dealers in the country. Since every home worker visits a hardware store at Irequent intervals and since hardware men have the widest possible acquaintance among (Continued on page 100)



The Amerillo Sumeworkshop Clab, of Amerillo, Tease, made these toys to record time. Were of the members besped and also dressed twenty-five dollar

Making Masts and Spars



The Hartford nears completion under Captain McCann's pleasted fingers. Note how purfactly mants and passin align

LR model of the sloop-of-war Hartford, Admiral Faceagut s famous ship, has now advanced far enough for us to make the spars and begin the rigging. New readers who wish to build this model which is the finest of all those I have designed for POPULAR SCIENCE MONTHLY, should refer to the three installments previously pubushed (P.S.M., Jan. '34, p. 57, Feb. p. 66 and Mar p. 71)

The rigging of the Hartford has more historic importance than that of any other ship in the United States navy because it was from the rigging that Forragus toshouted his defiant order "Damn the torpedoes! Full steam ahead."

The Hartford was steaming in line to the attack of Fort Morgan on August 5, 1864. Every man was at his station, including Captain Perrival Drayton and his staff. Near them was chief quartermaster John H. Knowles, The admiral was in the port main shrouds, twenty-five feet above the deck. Stience was maintained aboard until the Hartford was in easy range of the fort. Then the thunderous broadsides of the ship took part in the awful can-

During the action Captain Drayton fearing that some damage to the rigging might pilch Facragut overboard, sent knowles to secure him. "I went up." said Knowles, "with a piece of lead line and made it fast to one of the forward shrouds and then took it around the admiral to the after shroud. The admiral said, Never mind. I'm all right,' but I went about and

obeyed orders." Eater Farragut, undoing the lashing climbed higher stall. While he was here. one of the monitors struck a torpedo and sank. The Brooklyn. which was leading. turned back to go around what seemed to be a nest of torpedoes The whole line was in danger of being huddred together under the fire of the forts. Farragut then gave his immortal command and boldly took the lead the fleet to lowing. The tornedo cases could be heard rapping against the ship's bottom, but none exploded

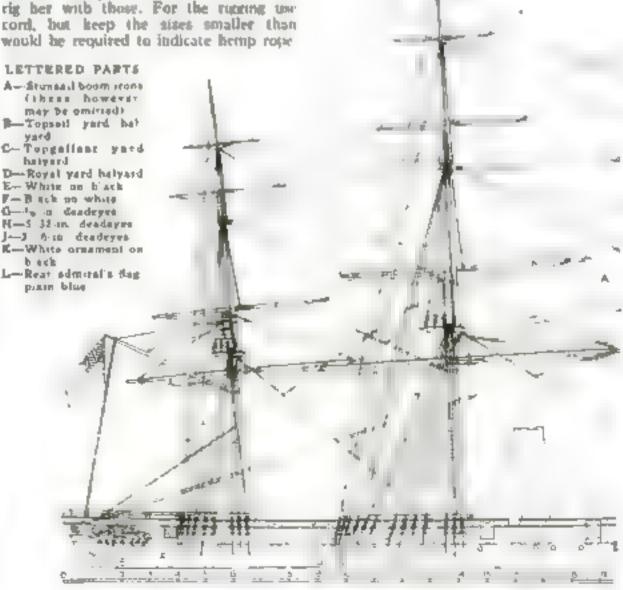
The rigging for the Huttord o much as for any other full ragged ha treship of her time, though here as elsewhere she is somewhat of a maxture of old and new ideas. She had wire standing rigging, and one photogrash of her shows what looks very much

like turnbuckies in place of deadeyes, but other pictures and all plans, old or newer call for deadeyes and lanyards, so we will rig her with those. For the running use cord, but keep the sizes smaller than would be required to indicate bemp rope

First we must make a complete set of spars. Their dimensions can be found from the rigging plan and the table on

The lowermasts are round and slightly tapered from the deck to the trestletrees, from which point they are square. They are slightly flattened to take the cheeks. the top edges of which are horizontal when the mast is in position—that is, not at a right angle to the masts. At the top ends the masts are squared a bit singular for the caps. The first band has a lag on it to take the pin of the trust; the second band has either one or three bolts soldered on each nide to take the futtock shrouds. and the third band has an eye abalt for the gooseneck for the spencer (trysau) gaff. These I formed from thin brain on a stick the same size as the mast I turned up a lug on each end and soldered them together, then put them on their masts at the right height.

At your intervals from the deck, up to the spencer band I put mast bands, to hold the supposed several parts of the mast together. These I made of writing paper gloed and wound around several times. The lower one is painted black for e pin band. For holding the belaying pins I made cycholta from 1/2-in. pins, and lrove them into the most through the band after I had soldered other pins of



for the HARTFORD Model

sufficient length in the eyes to represent the belaying pins. To prevent the sails from chafing on the mast bands, long battens are fitted over them on the foreside. These are called paunches. I made them from strips of Bristol board, notched to take the bands and gloed on. With the exception of the four bands especially mentioned, the masts are all white

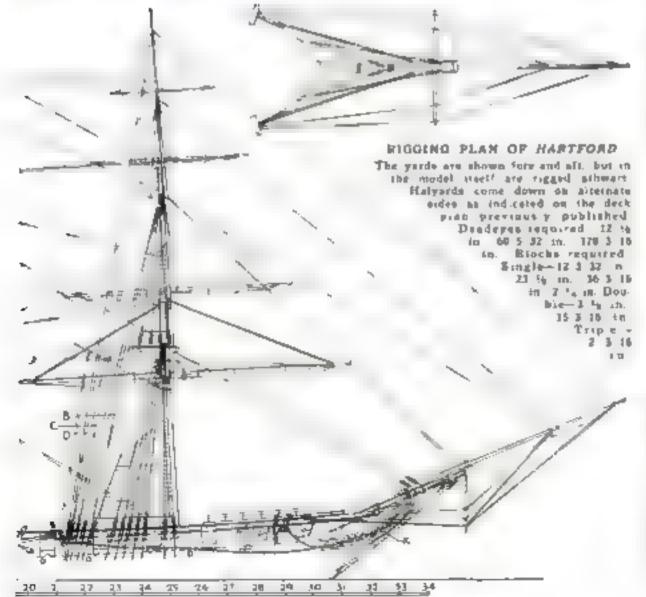
The bowsprit rapers slightly from where it comes out of the bow and is round with a flat top. The end is squared for the

By Captain
E.
Armitage
McCann





A view of the main lowerman to show deadeyes, shrouds and underside of top At John Bowsprit, jih boom, and rigging



cap. Just abalt this are cleats on each slide called bees, with buten through them for the topmast stays. Underneath are two 3 16-m. deadeyes for the bobitays. I stropped these—put straps on them—with wire, brought through the sprit and twisted together on top. On each side will be other deadeyes for the bowsprit shrouds, similarly fastened. On top there is a cleat for the jib boom end to rest on and another to hold the gammoning up, and two little cleats underneath for the

The topmasts are slightly tapered and are squared from the trestletrees up, with smaller squares for the caps. They have boles athwart near the beel for the fids, another at an angle for the mast ropes, and fore-and-aft boles 3/16 in, from the trestletrees for the ties of the balyards.

The topgaliant mosts and royal masts are in one spar, with practically no taper, but they have a dip or shoulder at the head of the topgaliant mast and royal mast, and a sharp taper to the pole. They are bored for fid boles and halyards. The masts are white where they double and at the pole, but a natural pitch-pine color where the yards slide up and down.

The pb boom tapers slightly from the cap to the beel and then slightly from there to the end but most of the thickness is taken off at the topmast topgalant and royal stays, where there are shoulders. Within the cap and also the extreme end are white, the rest natural.

The martingale (Continued on page 102)

How to Improve Your PHOTOGRAPHS

by using a set of

Color Filters



Inespensive gelar ne filtere can be mounted between birets of cardboard and slipped into a carrier establish to the sens

what we call white light. In other words, white light manus the blue rays uppears to be yellow light to our eyes. And a yellow object will reflect red or orange rays as attroughy as a white object

In a previous article (P. S. M., Aug.

By
Frederick
D.
Ryder, Jr.

33, p. 74) I explained how panchromatic film, even when used without any filer, gives good render-of color values in monochrome—that is, in shades of gray. True color rendering is not, however always de-

strable. In many cases far better pictures result if the strength of the color is toned down or stepped up with the aid of filters. Take the case, for example of a light yel tow house being photographed against a blue sky. It may (Continued on page 78)

HE introduction of panchromatic roll film and film packs opens up absorbingly interesting photographic fields to the amateur camera enthusist. All sorts of effects formerly possible only with professional equipment are now at the command of phyone owning the simplest type of hand camera

You can, for example, produce the most beautiful cloud pictures at inapshot speed, get weird moonlight effects in bright sunlight, do amazing tricks in taking pictures of flowers or gardens, and, in general, make the various colors behave to your photographs like a troup of trained actors. All these stunts and scores of others are accomplished by the proper use of simple and inexpensive color filters.

In order to use photographic filters so as to get just the results you want, you must have clearly in mind what a filter is and what it does. All light, as you know, is colored. There really is no such thing as white light. What our eyes see as white light actually is a combination of colored light. When you hold up a piece of colored glass, ted for instance the glass doesn't turn the light into red it merely cuts off or absorbs a certain percentage of the blue-violet and green rays in the white light

Similarly, a photographic filter is a substance which, when placed in the path of the light streaming through the lens of your camera, will absorb some of it and thereby prevent it from acting on the film.

The colored objects you photograph also are light filters except that they operate by reflection instead of direct transmission. An object that appears red, for example is one that is absorbing blue-violet and green mys. A bright veilow object is one that is soaking up blue light and reflecting the rest of the components of









Snapshots at Night!



THIS remarkable new "SS" film

Tribas whichie news Tesposad in a horse Now

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I thus the cours may be made and compare to the second proper to be a second proper to b

FINE CAMERAS . Ideal for Hight Snopshots

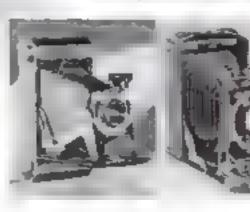


FILM Kudak SS.

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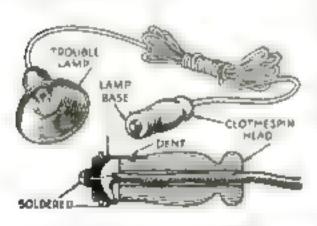
APRIL, 1914

6

HEAVY CARDBOARD CELLULOID WINDOW

An emergency window can be made of cardboard and sheet colluined and installed to replace broken gizes, as shown above

HEN a car window in shattered, it is sometimes a week or more before a new glass can be obtained and installed. A temporary repair however, can be made with heavy cardboard and a large piece of sheet celluloid of the type sold in auto supply stores for repairing side curtains Trim the cardboard to the full width of the window opening, leaving about three inches to space in the length. Then cut the opening for the window and stitch the celluloid in place with heavy thread. The makeshift window finally can be installed by inserting the bottom edge in the regular opening in the door, (see illustration), afting it until the top edge fits snugly in the felt groove at the top of the frame, and Jamming two wood or rubber wedges between the cardboard and the frame along the bottom cope on the inside to hold it in place.— J Z.



Trouble-Lamp Plug From Old Bulb Base

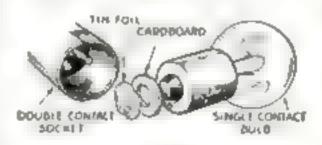
OWNERS of cars fitted with exposed dashboard lights can make a convenient trouble-lamp plug from the base of a broken bulb and the end of an ordinary clothespin. When completed the plug makes it a simple matter to connect an auxiliary extension to the car's battery. The handle for the plug is made by cutting the upper half from a wooden clothespin. Drill a three-sixteenths-mcb hole through the center and file the lower end to be a tight fit in the bulb base. Thread

Ingenious Ideas for car owners

Our Readers Furnish New Suggestions For Handy Repairs and Improvements

the extension cord through the handle, solder the wires to the filament leads in the base, and finally drive the handle into the base. Then, using a pointed nail, make three or four deep dents in the metal sides of the bulb base. These will serve to hold the handle in place. The same lank can be used to advantage on newer cars if the owners will install a beyonet-type socket under the dash-

board and connect it to the battery supply. For durability, it will be best to use a subber-covered cord.—C B



Repairing Headlights

IF VOLR car uses double filament bulbs in the headlights and they happen to burn out when you are traveling along some out-of-the-way road, you may find that the nearest service station carrier only the single-blament variety. Placed in the regular double-filament sockets. these angle-contact bulbs will not light, but by making use of some scraps of cardboard and a piece of foil from your cararette package you can make them serve. First cut a cardboard washer, making it large enough to cover the base of the builb and the hole big enough to allow the single contact to project through. Then fold the full to obtain several thicknesses Finally, with the washer and Lin foil held in place with a bit of chewing gum, place the bulb in the socket. Arranged in this way, the bulb will light as contact will be made no matter which way the light switch is thrown.-P, L. H.



Spark-Plug Tester

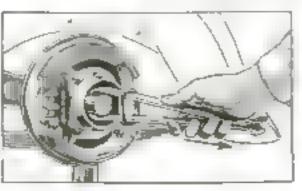
MADE from a pencil, the spark-plug tester above forms a valuable addition to any automobile repair kit. Sharpen both ends of a large pencil and then drill a small hole through it at about its middle. In use, the projecting lead at one end is held against the terminal on top of the spark plug while the other end is grounded against the motor head. If the spark plug is functioning, a spark will jump across the gap.—J. M. V.



Sponge-Rubber Mat

PLACED on the floor directly beneath the brake and clutch pedais, a rectangle of sponge rubber will cover any holes worn by the driver's heels and will protect the high heels of lady drivers. Cut the sponge rubber to the desired size and cement it to the flooring mat with rubber-patching cement or ordinary water glass (sodium salicate).—E. W. B.

Tool to Grip End of Broken Axle



BY USING two tire from and a large link from a chain you can improvise a good tool for grapping the end of a broken rear axie, as is shown in the illustration at the left. Samply slip the tire from over the axie end and then slide the link over the ends of the tire from, pushing it toward the axie until it bolds them firmly together. The projecting ends of the from can be used as a handle as shown at the left —A. B

A BLOW-OUT IN THE MAKING MAY BE IN YOUR TIRE RIGHT NOW





HOW GOLDEN PLY TIRE SAVES MOTORISTS' LIVES





NEW SILVERTOWN PREVENTS GREAT CAUSE OF BLOW-OUTS—GIVES MONTHS OF EXTRA MILEAGE—FREE!

ABLOW-OUT is like a saske in the grass. Unseen in advance, it strikes when you least expect it. Often when you think your dres are still good for thousands of miles. Often when you and your loved ones are specifing along some fast, crowded highway.

BANG! A blow-out. Desperately your hands grapthe steering wheel. With all your strength you clamp down the foot-brake. No use. Your car swerves. You can't steer. Trees, datches or speeding traffic block the way. Your lives are in the hands of Fate.

To protect motorists from blow-outs every new Goodrich Silvertown has the amazing Life-Saver Golden Ply. This remarkable invention resists heat. Rubber and fabric don't separate. Thus blasters don't form inside the tire. The great, unseen cause of blow-outs in prevented before it begins. The Golden Ply makes you 3 times safer than before. And here's proof.

Racing daredevils tested it not at breakneck speeds. On the world's fastest track. Gave it everything they had. Rubber got so hot it fairly smoked. Not one blow-out. Similar tires without the Life-Saver Golden Ply failed at one-third the distance the Golden. Ply Silvertowns were run. And what's more, the Golden Ply Silvertowns kept right on enting up the miles.

In addition to being 3 times safer from blow-outs with the new Goodrich Silvertowns on your car, you'll get plenty of autra mileage, too. For, with the destructive effects of internal heat overcome by the Golden Ply, the big, rugged Silvertown outwears ordinary tires by mentile.

No extra costi

Enjoy the priceless feeling of security every time you sit behind the wheel. Get more mileage than you ever got out of tires before. Play safe! See your nearest Goodrich dealer today about a set of Golden MRA. Ply Silvertowns for your car. And

Ply Silvertowns for your car. And remember, they cust not a peopy more than other standard tires.

FREE! Handsome amblem with red creeks reference to protect you if your will light goes out. Go to your Goodrich dealer rose 5//vertown Safety League, and receive one FREE, Or send told to cover packing and mailing) to Dept. 379. The B. F. Goodrich Robber Co., Akron, O.



Goodrich



Silvertown WITH LIFE-SAVER COLDEN PLA

Benjamin W. Hicks tells

How to Light

Your Miniature Stage

40 achieve the most realistic elfect with any miniature stage, you should install lighting equipment similar to that used on a regular stage Complete control of the light is essential, and each circuit should be provided with separate dimmers or rheostats. The border and footaghts should be wired for three colors-red, blue, and either amber or clear. Of course, if your stage is an exact model of any particular stage, choose the same colors that are used on that stage.

The accompanying illustrations and following instructions are intended to apply to the ministure stage described in two

A border light (in overe & capter out copied from a picture with a bine "eye" in the background, and a light socket atrip before being festened in its trough. One of the three color circuits is wired principles can be used for a model

previous articles (P.S.M., Feb. '34, p. 57, and Mar., p. 75), which was built on the scale of 1 in. equals 1 ft., but the same

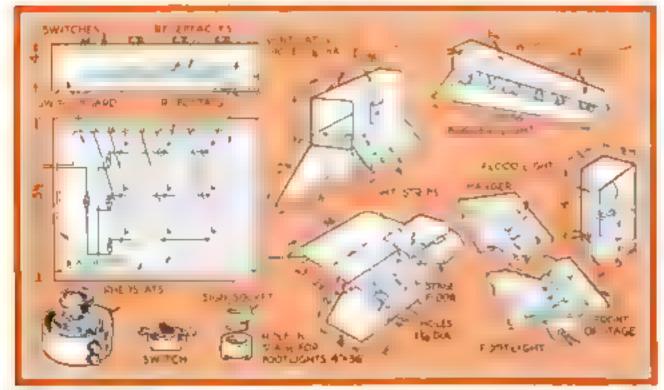
of any size or design

Good stage lighting does four things, namely 'Illuminate the stage; show the time of day and the season of the year, give the stage depth with light and shade; and provide the proper psychological effect with color lighting. Blue represents cold or night; red, fire and hate; green. spring and hope; black or a dark stage, death, night, or crime-

The equipment necessary includes two border lights, footsights, and a switchboard. Flood lights and other small lighting fixtures can be added from time to time as needed.

Most of the materials (see list on page \$7) can be purchased from 4. local supply house or electrical dealer The tin work can be done at the neighborhood tinner's for a reasonable sum if one is not equipped to do it

Footlights give a continuous strip of light across the front of the stage and should (Continued on page 86)



Plan view and upper edge of the switchboard, and sketches showing how the footlights, border lights, and flood lights are made. Compare these with the photographs at the bottom of page 56

What is the difference between HYDRAULIC BRAKES and SUPER-HYDRAULIC BRAKES?

Outstanding advantage of Oldsmobile a super-hydraulie brakes is the controlled hervo, or self-energizing. action of the brake shoes. The hydraulicallyoperated piston within the wheel exhiber (A) forces printary shoe (B) against the revolving brake drum. As the dring revolves it attempts to carry the expanding primary shoe with it. This effort, transmitted through adjusting screw (D) forces the secondary shoe (t.) into contact with the drumboth shoes weapping tighter and tighter against the dram until the wheel stops. Momentum of carmultiplies the braking power—the greater the speed. the greater the pressure against the brake drums. No previous hydraulie brake is self-energizing.



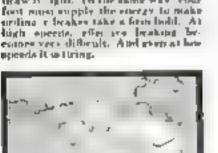
Manter by decade or limber to mounted change to the land postal person tang direct linkage with attendence fee tion, or had over all by period pre-nure is needed. Master calleder between Built uniter occurre to each deaps through pressure-tested steel tobing.



Later from may flued tank them s with equal pressure from all authors. In glasses report on all four broken in the 1934 Ohlogoshale,



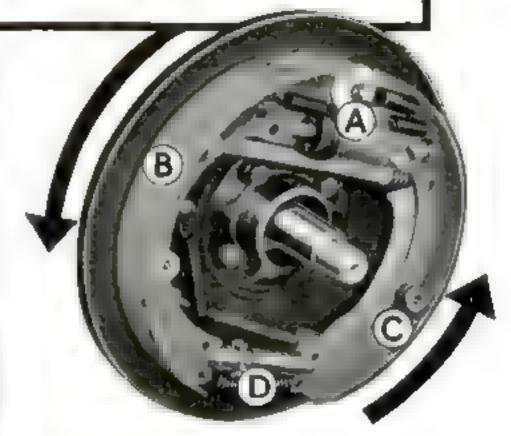
Throw a lases over a post and your they agree just be put the energy to draw it uplet. For the same way water foot cases an opty the othersy to make high operio, effer to braking bespendalt to thing.



Mechanical emergency brakes on root wheels act an rear service. independent of super hydraulic are Superior to entire brakens eye-Lightle . from of forpure two-above brake cars. With an Oldsmobile you can park no a steep bill while are a loting changes.



the animal supplies the energy to deast the know tight. The factor the animal travels, the tighter the know at applied. In the same was self-energiants brakes supply the energy in stop, he care. The factor the rate is traveling that greater the braking.



Oklamobile All-Feature models for 1934 are equipped with Super-Hydraulic brakes. The first self-energiaing hydraulic brakes, they grip amouthly with slightest foot pressure. Quick, easy, non-skid stopping under any road condition.

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1 Knee-Action Wheels. 2 Center-Control Steering. 3 Ride Stabilizer. 4 Counterweighted crankshaft, 5 Electroplated east iron pistons. 6 Syncro-Mesh Transmission—all silent. 7 Full pressure lubrication with rifle-drilled connecting rods. 8 Independent mounting of radiator, fenders and head-

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CRAFIEX

COLOR FILTERS IMPROVE PHOTOGRAPHS

(Continued from page 72)

happen that the light value of both the sky and the house are the same, and the house lines will fade into the sky

With penchromatic film in your camera and an equipment of filters, you can decide for yourself whether you want the sky brighter than the house or the house brighter than the sky. The same problem may octur in photographing flowers against various kinds of backgrounds or in mated groups. Filters will enable you to make the flowers stand out from each other

Of ALL the photographic filters available, the plain yellow filter is most common, These have been supplied for years in various strengths and graded as "light," "medium," or "dark." They increased the exposure with the film then available two or three times for the "light" grade, five times for the "light" grade, five times for the "dark." These filters only absorbed a relatively small proportion of the total amount of light, but the blue and violet mys they took out were just the rays to which orthochromatic film is most senutive hence the greater increased apposures.

Modern panchromatic firm also is sensitive to blue and violet aight, but in addition it is sensitive to light of all other conesclear to the deep red end of the spectrum. You are no longer restricted to yellow filters. Any color may be used that conditions call for

High-grade vellow filters made of opticalty ground vellow gave are obtained from several makers, but glass of other colors is expensive and hard to get. The finest color filters, such as those used by photo-engravers for the exacting work of making color printing plates and for other precision color filtering, are made from specially prepared and stained sheets of grinting crimented between thick pieces of outlies like perfect alone

tween thick pieces of optically perfect glass. These A grade trees are far too expressive for anateur use Fortunately however, the same grade of stained getatine in thin shorts I in square can be obtained for about fifth cents apure in any rolor. They do not fade or change color with exposure to light, but being nothing but plain getatine, they are mechanically delicate and must not be handled with the bare fragers or allowed to come in contact with moisture.

Theoretically, the best place for a gristime filter is between the front and rear sections of the less next the iris disphraum. For esperimental use this is an unhandy method, Front mounting is the only practical way for amateurs to mount filters.

O'E of the photographs shows an excellent experimental mounting that hoods three filters and slips into a 2 in carrier at tached to the lem. Three 2 in square gelatine filters are mounted, without cultime between two pieces of stoff, thick cardboard through whach holes have been cut alightly larger than the lens with which the filters are to be used

Cutting smooth round holes with a penkude through thick cardboard is tough work. If an expansion bit is available, the job can be done easily and quickly by clamping the layers of cardboard between two boards and boring the holes strught through

Mounting is simple. The getatine squares are laid over the holes in one cardboard, the other cardboard is placed over them, and the two cards are tachtly held while the edges are bound with black laintern-slide tape or strips of the proper width cut from ordinary summed paper realing tape. When not in use, each filter unit can be kept in a slip envelope made of strong manila paper.

You can buy a filter bolder that will

take 2 its, wide filters and attaches to the left by spring clips, or you can make a simple carrier out of sheet metal or card-board.

A good combination of filters for most amateur requirements would consist of two units of here titlers each fill one with the tracolor filters known as Wratten A (red., B (green), and (5 ,blue) fit the other with X1 (light green), G (deep yearow), and F (deep red)

A detailed description of all the possible tectal apparatures of filters would fill a large book but the principle, as a ready stated, is simple You use a filter to emphasize certain objects in the picture or to chaffe the relation between two of more objects.

Suspense for example you wish to take a distant accor on a day when the sky is overcast in a training gray and the distant portion of the view is enveloped in a night must Wishout a filter the resulting picture would hardly be worth taking

Try shooting such a view with the G (deep vellow) is er in front of the Jens With supersensitive parchromatic film, the exposure will have to be increased only about three times (one and one half dia phragm stops, and the distant portion of the view will be brought out in a way that was suppose you.

With high-speed orthochromatic film, the exposure with this filter would have to be intrased (wenty four times, a figure that will indicate to old me amateurs who have not yet experimented with the new panchromatic bim just how color sensitive it is

If conditions are very bad or you are most interested in bringing out the details of distant biomengs, try the A (red) and distresse the normal exposure by four and one half times or use the F (deep red) at ten times normal. These will bring out details almost invisible to the paked eye

On days when the air is clear and the sky intensely hade, these same filters will produce amazing effects. G will cause fleecy couch to stand out the fluity cotton, A makes the effect still more pronounced and coing F and at the same time underexposing a bit, will give you weird moonlight effects, especially on snow scenes.

The Bustrations at the bottom of page ?? will give you an idea how filters may be used to change the appearance of objects. The first was taken with supersensitive panchromatic film without any filter. The others were taken with the tricolor filters A, B, and C5 respectively. No changes were made except to increase the exposure according to the filter is not both how radius y different the various denta on the table a spear in these views. In fact you can, knowing which filter was used for each view, easily figure out what the actual color of every object in the picture must be!

Our winter series of four photographic contents proved unusually successful both in respect to the number of entries and their quality. The winners of the December content are listed an page 103. The November awards were amounted but month, and the January and February content winners will be published in the May and June itsues.

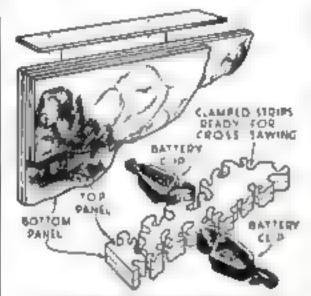
COLORING NEW PUTTY

When a new window pane has been put in, the putty can be colored by dusting a dry (powdered) color over it. The oil in the putty absorbs the color, and thus can be done at once without waiting for the putty to dry before painting it.—D. H.

SAWING TWO PICTURE PUZZLES AT ONCE

TWO picture puzzles may be fig-sawed at one time if the proper saw blades are obtained. An average of 250 pieces an hour is possible, as much time is saved in both the sawing and assembling operations

One should use what are commonly known as "double-tooth skip" blades having 33 teeth per inch. These gaws are slightly stouter than some of the lighter ones, being almost 208 in in thickness. As a consequence, puzzles made with them will be a



The presint are held at first with rardboard straps, then with small apring battery caps

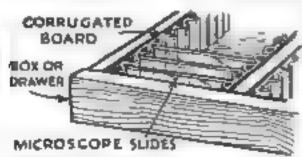
trifle known, and more care should be ever cised when sawing the interlocking keys. The budes will, however, turn sharpay

The two panels that he the same pire Stripe of cardboard slightly narrower than the combined thickness of the two panels should be tacked to the cares with short, fine brack, bank pine, or small wire staples. Drive the points into the center cores to avoid separating the piles.

After the combined punels have been halved or quartered, the tections will not be securely held by the cardboard strips and it is impractical to continue by this method alone. Obtain at least four small spring chipbattery connections. By hooking several of these over keys around the edges, no suppong can occur even while you are sawing strips or small pieces. When the strip or section has been completely sawed, remove the dipp and drop the mass into place.—W. L. Fat not

EASILY MADE BOXES FOR MICROSCOPE SLIDES

NOT having the facilities for making a wooden flung box for microscope slides. I devised the easier method of construction alustrated. Corrugated cardboard such as is used for packing and in some cardboard.

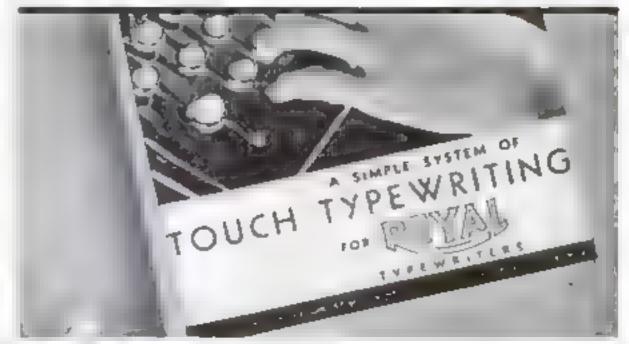


å ngre fored corrugated packing boards used as grooves for filing sway microscope slides

boxes provides the grooved guides for filing away the sides. These guides are merely glued in cardboard or wooden boxes of suitable sizes. They can be packed out if the box is too wide, or they can be set crossways in a narrow box.—Roster Bartlert



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ing like that all astrated, the maintenance of a glowing, cheerful fire is made easier and much dirt in the bouse is prevented ha ordinary large steel ash-pit door and frame is used on the exterior of the wall and cemented in with a mixture of 1 part cement and 2 parts sand

To make the morn side of the wall attractive, an open bookcase may be constructed as shown. The interior door should be hanged on the far side of the opening so that the door, when opened will not interfere with transferring the logs from the chest to the fireplace. It the base of the bookcase is made nufficiently large, a place may be reserved for newspapers or small knoding.

A good lock should be placed on the interior door to discourage intruders from gaining access to the house. A lock on the exterior door ordinarily would not be satisfactory for the reason that one would have to get the key and unlock the door whenever logs are to be placed in the thest. The exterior door should be painted the same color as the wall exterior.

In a house under construction, little time is required to provide such a log chest. In a constructed house, however, a good cold chisel is necessary to cut the hole through the wall. After one or two bracks have been taken out the rest can be removed easily.—Earl E. Moore.



REUPHOLSTERING OLD CAR

Is your car needs reupholstering, you may obtain suitable material from an auto junk yard at low cost. The leather seats and backs of large cars are best; they are of good quality and may be trimmed to fit a smaller car Be sure the leather you buy is not too old or dired out.

The old upholstery may be removed entirely except the springs ance the padding will be attached to your new material. In the repair illustrated, the back was simply tacked to the wooden frame, and the sea was sewed on at the bottom, as it was an allmetal frame. The entire repair was made with genuine leather for less than \$1.50 plus a few bours' work.—]. D. Staggs

BELLOWS SHIELD AIDS IN AERIAL PHOTOGRAPHY

THE next time you make a trip by plane, take your camera up with you Excellent aerial photographs can be made with amateur cameras by adding a bellows shield to prevent the bellows from collapsing in the propeller blast

A simple homemade shield that incloses the bellows from the body of the camera to the lens front is sufficient, providing it affords complete ngidity. To remove or install the shield, the lens front is pulled out, and the shield then slips readily past. The parts are cut from stiff cardboard and binged together with medical adhesive tape.—Almistead Wharton



The shield is of a size to stay rigid when the less front is in the infinity position

ANTIQUE BOTTLE HOLDS GROWING IVY PLANT



AN OLD-FASHIONED one-purt demojohn of the round-bottom variety makes an antique-looking and exceedingly pictur esque wall receptacle for an ivy plant Buttles of this variety are found in many homes or may be purchased at most ortique shops for about half a dollar. Fasten one end of a brass chain tightly around the neck of the bottle and form a loop in the other end of the chain

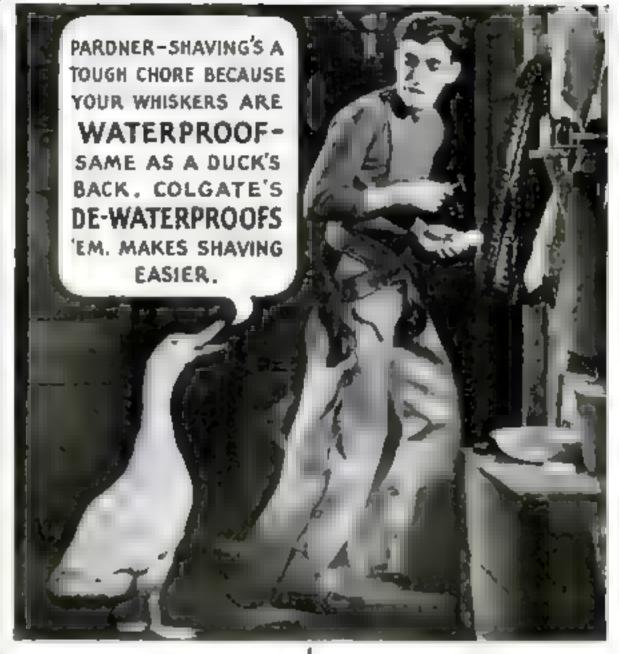
Place in the bottle an English avy with most of the soil removed from the roots or any Indoor plant that will thrive to water. File the bottle with water and hang. It in the sunshine on the window frome in the living room or in the sun parlor The traing plant hangs gracefully over the green-timed glass.-George A. Smith.

SANDPAPER BLOCK FOR RABBETED EDGES

RABBETED edges can be sandpapered easily with the aid of a holder made from two blocks of wood. The blocks are placed gainst the surfaces of the rabbet as shown below and then fastened together with a screw at each end. The screws are loosened for inserting the sandpaper and retightened. This tool will do a clean-cur job.—George E. Kilpatrick, Jr.



A two-piece sanding black that saves time and insures a good job in smoothing rabbets





Every whater on your face is wrapped ut a tough, waterproof coating of oil that makes it hard to cut.



Once you remove every trace of that waterproof coating from every whisker, you get a shave as smooth as a barber's second time over.



But the trouble is most shaving creams woth't, and't remove all the waterproofing. Most shaving creams froth up into big bubbles-and you can't get a lot of big bubbles close around every whister,

But Colgate's Rapid-Shave Cream whips up into militons of tiny little bubbles.



Thousands of these tiny lather bubbles go to work on every single whater you own. They crowd close to it. They completely surround it . . . strap every trace of waterproofing from it. These tiny bubbles emulafy that only, waterproof coatingand wash at completely away.



Then they soak each whisker so soft that your raror slips through it like a knife through butter. Try Colgate's and see for yourself how much easier the small bubble lather makes your daily shave. The large 35¢ tube is now only 250-buy it today.

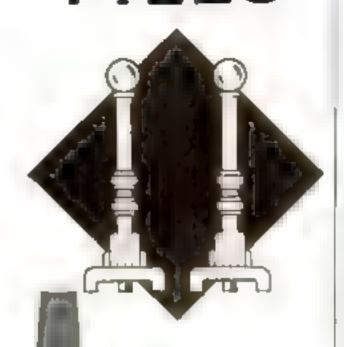
P. S.—For a perfect word-up to a Colgate there, try Colgate's After Shave Lation and Culpate's Tale for Men.





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JIG-SAWED LAMP AND SHADE

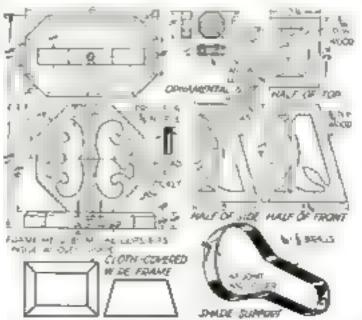
ORNAMENTAL lamps of many types may be made by the owner of a motor-driven jig saw. A sample of such a lamp is shown in the accompanying photographs and drawings. It was designed and con-

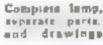
bands are on, the gun is ready for action In shooting, the drum is turned to he

right --- GEORGE PEL NOAS

structed by Robert Por zer at Oshkosh. Was and wor a or se in our last jig-sawing contest.









HOW TO CUT HEAVY WIRE INTO SHORT PIECES



The wire is out on the corner of a hurdened used block, and the scale serves as a gage

WIRE that is too heavy to be cut by phers can be handled conveniently in the manner illustrated above. Take a square block of hardened steel with sharp corners, taghten the end of a scale in a small clamp, and grip both together in the vise. Have the end of the scale in line with the corner of the block. Standing over the Joh, you will find it quite easy to see when the end of the wire in line with the required measurement, and a blow with the hammer will then cut off the piece. If the wire is not cut entirely through, it will break off when bent. For a number of pieces, this setup saves time.—H. Moost

A QUICK-ACTING CATCH FOR CELLAR WINDOW

Tilk automatic celas window catch
a astrated, which is
made from an ordinary were coat book
as no improvement
over the usual book
and eye and other
homemade were last
rners used for this
purpose it is also
use full on certain
eterm or other win-



Cost hook used as a se se ser window catch

down of a similar type because it is positive in action and easily released.

Bend the end of the book as shown and screw the bonk at the proper place on the joint or ceiling to catch the window when swang open. The hook is screwed in for about half of its thread length into the joint to leave it sem flexible. The raised window is released by a pull,—Braproup Chever.

MULTIPLE HOLDER KEEPS SMALL BRUSHES CLEAN

FOR cleaning or keeping soft the type of artist's brushes used in positing ship models and other small work, I use the glass tubes in which certain toothbrushes are sold. Cummin test tubes would do as well. The tubes stand upright in holes in a block of wood. If the tubes happen to be oval, enlarge

MATERIAL TO STATE OF THE STATE

The brushes are surpended in glass tubes

the holes The brushes are suspensed in the cleaning fluid or turpentine in such a way that the bristles are just off the bottom. This is accomplished by dipping a short piece of wire through a bole drilled in the handle of each. These wires may be set in boies on the base when not in use G D GHARDET, JR.

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REMOVING A TIGHT MILLING ARBOR



Even a badly stuck arbor can be removed with a slightly kinhed brase rod and a small hammer without causing damage

THE ordinary method of removing stack milling arbors is to drive them out with a beavy rod, but if an arbor has been in a long time and has rusted a little, it is sometimes next to impossible to get it out without battering the tang and otherwise injuring it. The difficulty is further aggravated

by striking the driving-out rod with a beavy bammer, which damages spindle and bearings as well as the arbor

A far better way is to use a bram knock-nut rod about in in diameter. This should be bent slightly in the middle, and then straightened enough to leave a small kink After it has been inserted, it should be struck a succession of sharp blows with a hammer weighing about 8 ounces The rod, being small in diam-eter, springs slightly, but this tendency is limited because the kinked part strikes the hore of the spindle. Two of three minutes of this treat ment will loosen the worst Arbor.

Some arbors are provided with a nut to take them out

but this is not always effective, and an arbor has been removed by the method just described after the threads in the put had been completely stripped.

Lathe centers may also be removed in this manner when they will not readily yield to any other treatment.-G. J. M.

CENTER FINDER FOR LATHE

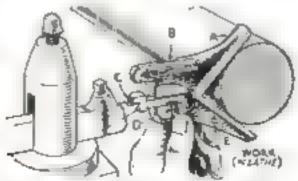
In Transpot on the lathe, much time is usually lost in setting the bit so it will produce a clean cut without undue wear on the tool Furthermore, different metala requare a variation of the position of the bit in relation to the center For instance, in turning steel, the work can be accomplished with the prestest efficiency when the cutting

edge of the tool is just above the center Cast from however, is usually turned with the tool as near to the center as the operafor can guest, while bruss will cut cleaner and with less tendency to charter when the cutting edge is a little below the center In facing work it is particularly irritating when the finishing cut leaves a small projecting nib at the center because of the wrong setting of the tool, especially as this indicates that for a consulerable distance from this the work is not perfectly flat.

To minimize these difficulties, some workmen set the tool point by the headstock center, but this is not always either conven-

sent or practicable. In some instances it does very well until it is necessary to grind the tool, and then the muchinist is at sea again with only his well-worn guess company for

As a remedy for this, the device shown below was devised. It is composed essentially of a 90-deg. V, a spirit level B, and a sliding hit abutment C, together with a spring E



The center finder broken away to show how it is slotted for the tool gage and spring



and stop screw D that limits the movement of the abutment and tends to keep it in an outward position. The outer end C of the abutment is so constructed that its sp is ex-actly on the center line that is assumed to pass through the corner of the mouth A at the spex of the angle.

It will now be seen that if the angular opening is placed against a round bodyfor instance, the tailstock spindle or a chuck on a lathe-the cutting point of the tool bit may be set precisely on the center of work in the lathe by adjusting the holder in the tool post until the bubble B of the level is central with a line etched on the glass, If it is desired to set the tool below the center, the outer edge of the bubble is made to come into a ignment with the line. For steel, the tool point is adjusted to ruse C above the center until the inner edge of the bubble a even with the fine

In constructing this bubble center finder, the position above and below the center for the different metals was experimentally determined so as to obtain the best results with the least wear on the tool-bit culting edge, and also to enable quick and handy manipulation in setting, by the pressure of the bit upon the ficel of the abutment beneath C, which causes the mouth A to press against the work by recession of the spring F

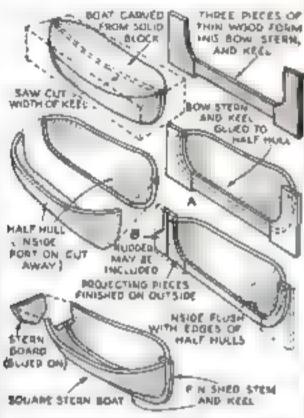
The device will accurately center any lob for turning or facing from 1/4 in, to 1 ft, or more in diameter and has been found to be a time saving accessory for use with the lather-George J. Museock

Is that tiny retaining screw in a door-knobpersistently works loose, but a drop of sheller on the threads.—E. S.

CARVING SMALL BOATS FOR SHIP MODELS

SMALL hoats for ship models are usually carved from a solid block. Better results can be obtained with less chance of sputting the ends by the method idustrated. I have a 2/1-in, whaleboat that was curved from white pine to less than 1/16 in in thickness.

Cut a block to the greatest dimensions of the boat with an allowance for saw tuts and sanding. Neglecting all details such as rubbing strips, moldings, keel, stem, and stempost, mark the plan on the tup; and, on the side of the block, mark the vertical section through the keel Carefully draw a fore-andaft center line extending entirely around the block. Saw out the shape of the bost on the plan and profile lines, round the bottom to shape, and carefully from the lines of the



When shaped on the outside, the block is cut into two haives, which are passes to hollow

punwales. As the center lines are cut away renew them, being careful to do so before they are entirely lost

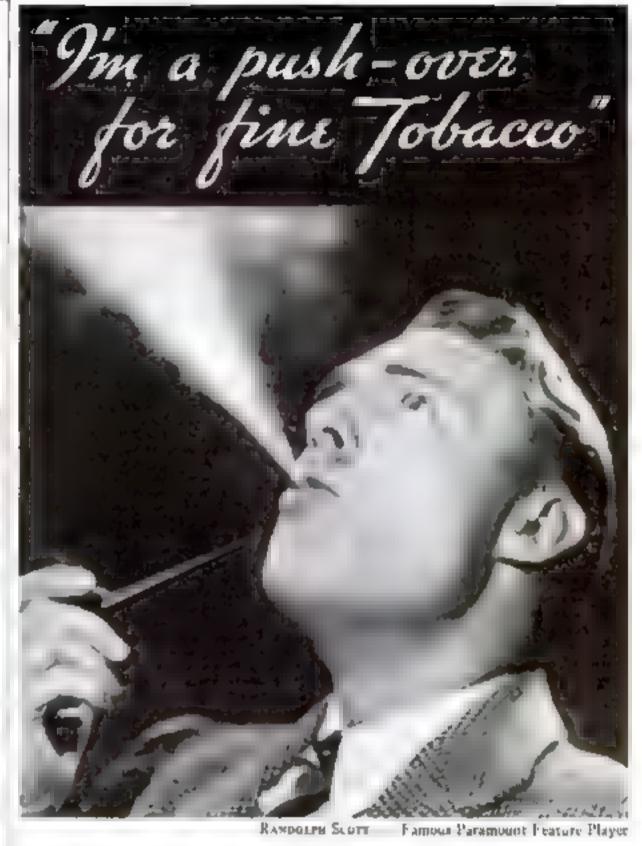
Turn the hull bottom side up and, with a coping saw, carelully make a rut the width of the keel all around the center line. Carrythis cut through note the half is the ideal in half. With a small goige and sandpaper, work the halves of the half down to the desired thickness.

Wood of proper thickness is now glued to one had of the hull along the saw cut as at a This should be in three pieces, cut so as to e minute the weakness of cross grain. After the give is set these pieces are faished flush with the inside of the hull, and the other half hu is gived in place. The centerpieces projecting on the outside are then finished to shape as shown.

In square stern models, the part tepresenting the stern marks is at away when hollowing the haves of the hall. When all inhoard details are completed, a piece of the wood is glosel across the stern and shaped to the hall.

A rudder may be in one piece with the sternpost by representing the dividing line with a V-cut filed along the proper line as at B before the parts are assembled

Melding or heading, rubbing strips, and the like are made of thin strips of Bristol board glaced in place. Depending on the scale, Bristol board or thin wood is used for seats and other thinds details. Paint should be applied in thin, clean-rut toots with a small brush.—G. I. Jotevson



Five tobacco is a weakness of mine. And often I'm tempted to try the most expensive kinds. But fine tobacco, I've discovered, isn't necessarily high priced.

For steady amoking, I like Union Leader. Its smooth, well-matured Kentucky Burley never tires my taste; It's so fragrant, full-flavored and biteless.

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Use it also on your car for shopping leaks in the radiat a bose connections has tank oil and exhaust lines. For participal crarked water jackets and crark one hear cases for tighten ne loose bab caps, man guards, lamp and tire supports, etc.

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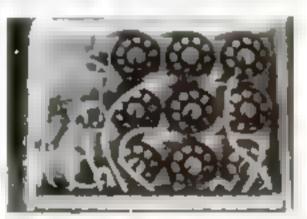
HOW TO LIGHT YOUR MINIATURE STAGE

(Commund team page 75)



retaining ropes from the

sockets and asten them in place, making certain the sockets will not turn. Were every third socket as shown in one of the photographs using asbestos covered wite. When all three circuits are wired, solder all tecminals so there will be no loose connections.



Switchboard with back removed to about thousestate, main away his and color switches

Postlights, border lights, flood light, and switchboard with four switches, showstat knobe, and receptacles in edge

Tape the wires where they come through the tin and use loss stong bushings to keep the lin from cutting the page.

Which ight strip to prace drill four botte, through the trough and through the edge of the light strip, being careful not to bit the sockets and wire with the drill and fasten in place with 12 in, sheet metal acrews, which will cut their own throad as they are acrewed in. Instead of using the acrews, you may solder the strip in place. Next solder small hangers so that the footnehts will not fall through the hole made in the floor of the state when the trough is set in place. A strip cut from the stage floor about 4 by 35% in., as close to the front as possible, is necessary to set the foothers in.

The border light (see drawing is hung from the top or the stage. It is made the the not ights, es not that the trough is of a offerent shape. The small flood light shown is simple to make and will be useful for light.

unit stenes from the sole as well as we special effects

The positribboard is made of white pine lined with in n. asbestos board. The fronand back namels are made of asbestos wood 11 in, thick The how is 4 by 131/2 by 17 h and the front and back are each 15 by 16 in. The sw thes and rhensiats are mounted directly on the front panel. The receptacles supplying current to the different pieces of equipment are mounted in the too edge. of he hox. These receptacles, ran be purchased at the tenrent store and are the type used for floor plugs. They are installed through holes 1% in in diameter Ad wir ing is inclosed. The back should be drilled full of 💥 in holes for proper ventila-

et a much a page 87.

HOW TO LIGHT YOUR MINIATURE STAGE

(Continued from page 80)

List of Materials

- 54 Intermediate base sign sockets (\$6.48)
- 54 Interpediate base S-11 sign harps, 10 wates, 110 volts, in colors as follows 18 red, 18 blue, 18 clear or amber (\$13)
- Toggle switches of type illustrated (\$1).
- 9 Recepturies and plags (\$1.35)
- 9 Rhenstats, each 1.0 volts, 60 watts (\$. 5 34)
- 50 ft. No. 15 asheston-covered were for inside of ton exhis and border lights 13 R No. 14 asbestos-covered were of inside of sw chboard and 75 ft No 18 lamp cord to carry current from switchboard to bordets and footughts (\$1)
- 3 Insulating bushings 36 in. in diameter and 1 bushing 55 in. (10 cents)
- N'ond for switchtnard 2 pc. 34 by 4 by 17 ln., and 2 pc. 34 by 4 by 1336 in. (10
- Asbestos wood for switchboard: 2 pc. 3/16 in. by 13 by 16/6 in. (78 cmts).
- Tin, No. 26 gage: 3 pc. 36 by 234 in. for socket strips, 2 pc. 36 by 1156 in. for making border trough, 1 pc. 36 by 1214 in not foot! ght trough, 1 pc. 12 by 15 (n for ends 183, inc uding bending)

Solder (10 cents)

Paint Fiat white for Inside reflectors flat black for outside switchboard and corders, color to match stage floor for outmile forthights.

Note The peters in parentheses are using he as the paid in Omaha. Nete and are given only to show the approximate a set. There is if he are alternate smaller and upon the part of equipment purchased and rough trade practice.

tion, as the rheoitals get quite warm when in use for any great length of time. The wiring imide the switchboard abould be done only with ashestos-covered wire, and all connections should be carefully soldered. The wiring disgram on page 76 shows how the wiring is done, and one of the photos gives a picture of the switchboard with the buck

Splice the Jamp cord carefully to the proper wires coming out of the border and footlights Solder each joint, then tape it first with rubber tape and finish with regular friction tape Next, fasten a regular drop-cord plug on the other end and mark each one. Plug into the switchboard and then ping the switchboard into the house supply. When all lights are on. only 540 watta of electricity at \$10 wolts are used. A bravy drop cord will carry the load safely. Never overload the chrostate, as they burn out quite easily. Never connect more

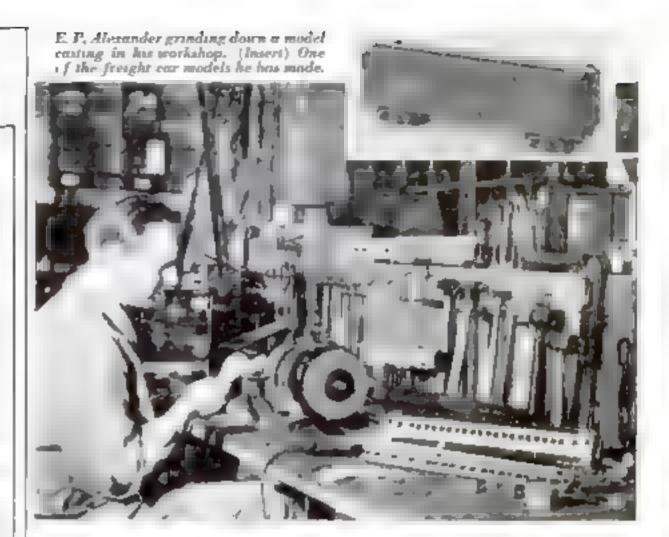
than 60 walts to each rheostal.

The most important thing in regard to stage lighting is the effect of colored lights upon painted surfaces. Because of the lack of pure color in both lamp dyes and pigments, one must carefully consider the action of light on the painting so as not to spoil the effect desired. Blue light on buff, and red on green give a muddy and undesirable color. Because of the variation in coose pigments and dyes, it is difficult to describe the effect of lights on painted objects, therefore it is possible only through experiment and experience to obtain the desired results.

On the switchboard, the red, blue, and clear circuits have a separate switch, which can be used to turn out the colors not wanted in any special scene. Another switch is used to

control all the lights

Three useful sets are tilestrated—an interior set, a castle set, and an outdoor scene using a sample set house (Continued on page 89)

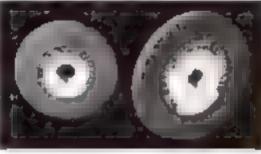


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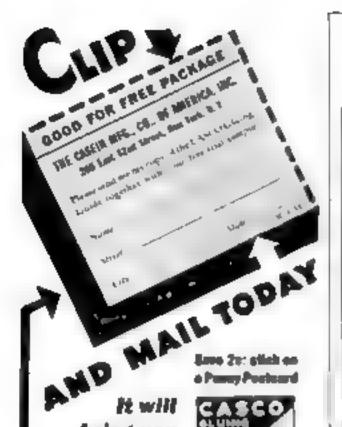
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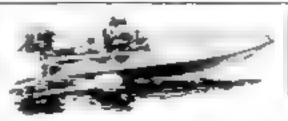
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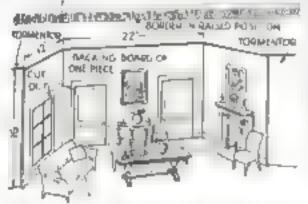
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HOW TO LIGHT YOUR MINIATURE STAGE

(Continued from page 87)

and set tree, both being quite easy to make. The interior set is one of the most interest ing to make. The walk are cut from a single piece of wall board, land out as shown in one of the drawings. The doors are cut out and hung with cloth for hinges. The walk are painted a light tax and spattered with red and blue. The spattering is done by filling a stiff brush with paint and drawing a knife blade across it so as to throw off a spray of small spots. Woodwork and doors should be painted brown. A border is necessary to mask off the top of the set and give the effect of a ceiling. The furniture can be made or purchased at the five-and-ten-cent store and repainted brown. Pictures for the walk



The doors of this set are cut so they can be spened, the window is backed with gauge

may be prepared by mounting old thech and magazine pictures on cardboard and pointing a frame of gold or black. Windows in such a set may be cut out and covered on the back with gause.

The castle set illustrated on page 76 was copied from a picture to show that stage settings may be adapted from illustrations in magazines or catalogues. A blue cyclorama forms the background. The castle and bedge are cut-outs made of wall board. The steps, wall, and posts are made of wood. These pieces are interchangeable with any other set

The other outdoor scene contains only two new pieces, a set bouse painted on present wood composition board and a set tree of wall board. The other pieces—the "cyc," wall, and wood wings—were used in other sets

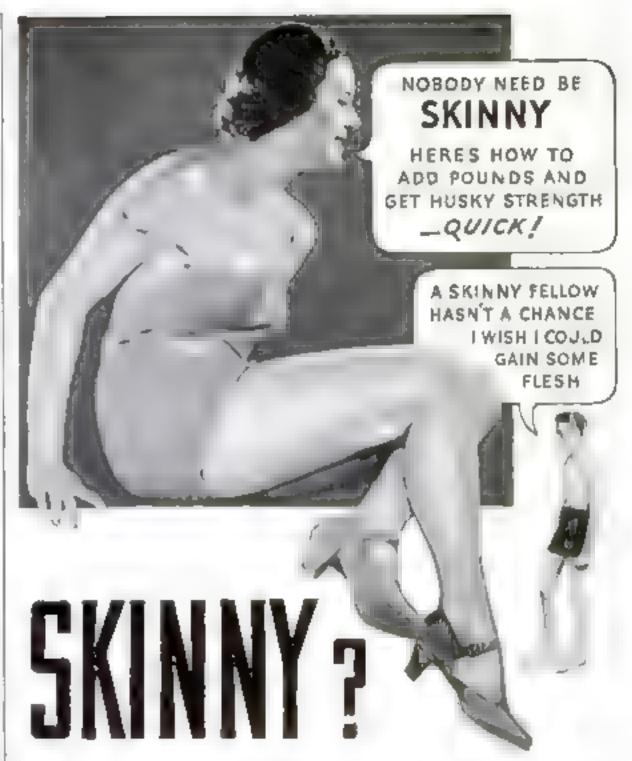
Success to any line of work or play comes from penetice. Stagecraft is perfected in the same way. Only by experiment with the minlature stage in it possible to become really efficient in its use.

This is the third and last of a series of orticles on building a minicture stage. Additional articles on this and similar topics, including the making of merionettes, will be published if a sufficient number of readers request them. Please indicate what subjects you are most interested in.

DRILLING THIN STOCK

In is sometimes necessary to make a true round hole in this metal stock. Where a punch and die are not available, this may be readly done by clamping the material very tightly between two pieces of wood. First drill a hole in the upper piece of wood the same size as the hole required in the metal. Scribe a circle of the same size on the metal and locate it under the hole in the piece of wood. Clamp tight and drill through. Shim stock 1001 in thick can be drilled by this method; and several pieces can be drilled at a time, or only one as preferred.—W. T. Sazaman

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Graceful Candlestick Forged at Low Cost from Band Iron

THE use of candles has increased to a great extent during the past few years. While in no way supplanting our modern illuminasing systems, they seem to provide just the right atmosphere for in imate, informal gatherings and dinners. The candieholder illustrated in easy to construct and can be made by the home craftsman at very WIN COST

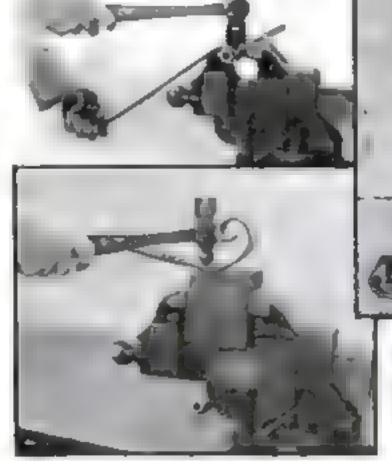
The body is made from a piece of band from 14 by 154 by 221/4 in. The ends should be heated and flared to a width of 296 in , as shown at A in the drawings. To enhance its appearance, the body should be closely peened with a bammer as should all of the separate parts before the assembly After the body has been flared and peened, the length should be about 2334 in. A siight variation in this length will not affect the general appearance

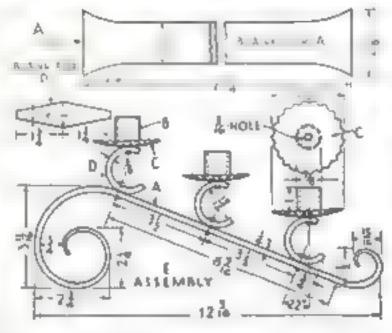
The scroll ends on the body are formed by bending around a piece of pape and by shaping in the hollow end of a block of wood, as shown in the photographs. The ends of the iron should be heated to a cherry red calor before the bending is

attempted.

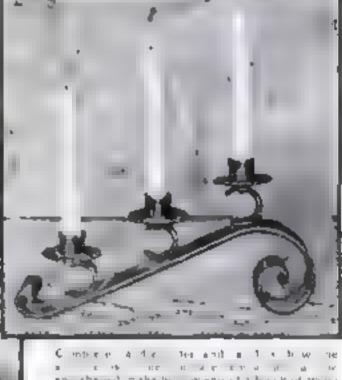
The details of the individual candleholders are shown at B_i C, and D. The cylinder B is formed around a piece of 1/2-in pipe from a blank of 14-gage galvanised sheet iron 1 by 25% in. The joint is brazed or soldered, Since there is a tendency for light metals to expand during the peening process, the piece should be peened and then finished to the use shown before it is formed into a cylinder. The edges of the circular

plate shown at C should be scalloped as indicated, but do not attempt to make the scarlops symmetrical. The plate should





be slightly cupped by hammering it against a block of wood, The crescent shaped piece D is formed around a piece



an the ed nake by swenu of a look of word



The circular plates for each candie socket are seel oped and al ghely supped. At Joir An assembly drawing and data is of the parts

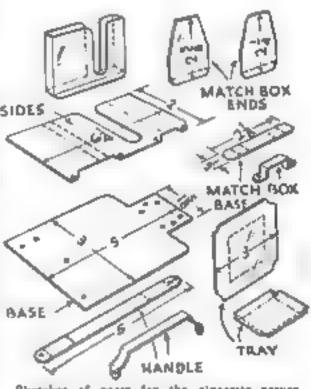
of 1-in, pipe. The cylindrical piece B may he either soldered or brased to the plate C. The individual parts are secured together and to the main body with 3/16in, from rivets. The assembly is shown at E in the drawings

The completed holder may be finished in a variety of ways, or it may be left unfinished. The holder shown in the photograph is finished with flat black paint, which gives a pleasing appearance. This is the conventional—and always satisfactory-finus for from - Kendall Ford

AFTER-DINNER SERVER FOR CIGARETTES

A CIGARETTE server of distinctive design with four separate ash trays may be easily made from 18-gage soft sheet copper. All the pieces are bammered on one side before being bent. The trays are hammered flat, and are bent to shape over a wooden block, which is held in the vise as shown

Ravet the parts together SIDES with No. 14 brass escutcheon pins. The pieces are colored after they have been assembled. Dissolve a small bit of liver of sulphur in about a quart of water, then, after washing the trays and holder thoroughly in soap and water, immerse them in the solution until they turn brown. Finally wash, dry, polish, and lacquer them. Use a clear brushing lacquer or a lacquer sold for protecting poltshed metal from tarmshing. -DICK HUTCHINSON



Sketches of parts for the eigerette server

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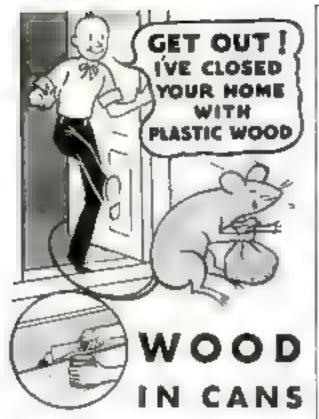
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By Herman Hjorth

HILDREN-and grown-ups, too-get much enjoyment and satisfaction from observing birds and listening to their thereful songs. There is no better way to entice birds to build nests nearby than to provide comfortable boxes or bouses for them

The bird houses illustrated are built very substantially and will keep the small feathered occupants warm and cosy during cold and inciement weather The design, for which I am indebted to my friend and collecture Mr. H. A. Cariberg, represents a minuture log cubic. It mables many variations to

The first step is to nail together an ordinary bird house consisting of two ends, two sides, bottom, and roof It is best to use 16-in stock for this. Any kind of scrap lumber

may be used in its construction.

Lay out the parts according to the dimenstore given on the drawing it may be well to bore the entrance hole before sawing out the boards, as a small, thin board spats easily when a large hole is bored in it. Bore the hole slanting a little toward the top of the house to prevent rain water from entering. The size of the hole depends upon the

type of bird for which the house is intended A tabulation of dimensions for various birds will be found on the following page.

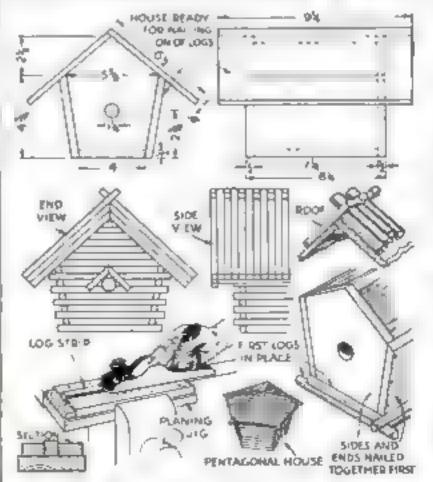
the following page.

Now saw the boards well outside the lines marked.

Nail the two ends and the two sides together and plane them to the lines so that they will be of exactly the same size. Plane the bottom carefully, because it should fit tightly between sides and ends. Hore a couple of ½ in bottom for dramage.

Nail the bottom and the two ends together Cut a stick to the same length as the bottom and nail it between the ends at the ridge of the roof to make this point firm. Plans of any projecting parts of the bottom and the stick flush with the ends, and then nail the sides to place

The "logs are sawed from a ½ or egen board. Plane the edge of the board and gage its thickness parallel to the edge. Rip off one "log" and plane the rough, sawed edge in a planing jig made.



End and side views of a typical bird homes, how "logs" are placed and applied. And a suggestion for a five-sided house



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List of Materials

No of Pieces	Description	'n.	W	1
7	Ends	74	624	5 3 is
2	Sades	+ 2	434	pta
	Bottom	54	4	714
2	Root	56	676	954
I	For wall logs	1.3	Q.	17
2	For roo! logs	56	0.2	16
North.	All dimensions are	gives.	in makes,	

as shown in the drawing. Plane the edge of the board again and repeat the operations aptil mough loss have been made

Nail the logs to the sides and ends as shown m one of the sketches. The ends should be covered right up to the ridge before the two %-in, roof boards are nailed in place. These are also covered with logs as shown.

It is perhaps better not to provide a perch below the hole, because sparrows will alight on it and annoy the occupants of the house, sometimes even driving them away. The song birds do not need the perch anyway, because they are able to fly directly to the bule.

The house should be stained or painted a rather dark, subdued color Bright vivid colors and shiny surfaces do not appeal to the bards. If paint is used, it should be flat dryang. If stain is preferred, the house may be given a cost or two of linseed oil to help preserve the wood. Woods best susted for outdoor work are typees, cedar, redwood, and white pipe.

This is the seventh of a series of simple tenodicorking erticles by Mr. Hjorik, Suc. testions for the subjects of future articles will be welcomed from readers.

HOW TO DESIGN A HOUSE TO SUIT ANY BIRD

M ANY questions usked by readers about the construction of bird houses can be answered by reference to the following tabulation. It originally appeared in a some-what different form in an article "Houses the Birds Really Like," by F E Tusti 100 and A. G. Brown (P. S. M., April 76. p. 781

1000	Plant not avity	Depth and	Abne Bue	Departed of entre
Worbirds	5 + 5	1.	- 6	2
Roben	ar t	16		4
Chickadees	41.5	6-10	6. 4	1.4
Titreme	4 1 4	9.70	4 5	114
Northatches	4 9 4	5 30	6- K	116
House ween	414	6- 4	1 6	
Senick wern	4×4	6 5	1 6	1
Condina sees	-4 ± 4	6. 8	1 6	1.5
Violet-green smallow	5 1 5	6	E- B	i i
Tree quallow	5 = 5	16	1.3	1.
Barn qualities	6 + 6	6		
Purply martin	426	6		2 ,
SADE ADDRESS	6.6.6	6	4.1	40
House-finch	6 = 6	5	- 6	7
Starling	ô x ń	\$4-18	14-16	7
Phrein	6 x fi	6		
Crested flycatcher	616	8.10	6- 8	7
Flicher	7 ± 7	26-18	14.16	2.
Guiden-fronted wondpecks	v 5 x 6	12-15	9.12	2
Red-braded woodpecker	8 8 6	12 15	0.12	Z
Donny woodpecker	4×4	8.10	6- 8-	14
Hany wentpecker	0 1 6	12 15	9.12	1 5
Screech out	8 2 9	1.7 13	9.12	3
Same whet our	016	10-13	4-10	2 ,
Barn owl	10 : 38	15-15	4	6
Spartor-bank	8 1 5	12 15	9-12	J
Wood-duck	10 x 11	10-13	3	6
"One or more sides op	er.	** 40 40	ics open	

North All dimensions are given in inches.

"YOU SAID A PIPEFUL," OAK PARK MAN WRITES

The enthusiastic pipe emoker tries and tries and tries to find the pipe tobacco of his ideal. He is always searching for that one tobacco which will at his taste exactly. Some seem good for a while-but "they don't last."

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Gratiemen:

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> Young truly, VIC OTHEN

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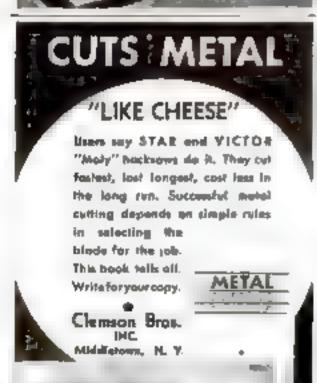


GEEL THAT CRACKED WALL LOOKS TERRIBLE



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Miniature

IGLOO

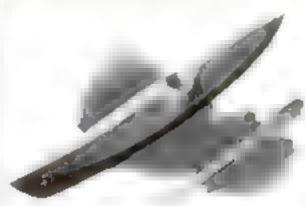
CONCEALS PASTE POT

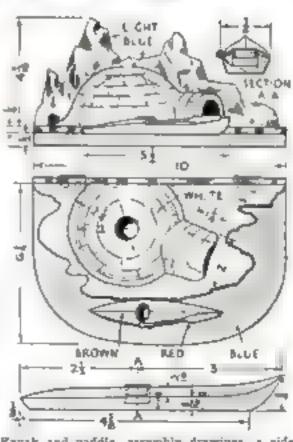
HIS desk ornament—a model of an I-kimo's snow igloo on an ice cakehouses a paste put, while the puddle on the knyak serves as a letter opener.

The base of the ministure is a piece of \$5in, plywood with an elliptical front edge Bore a shallow depression to fit the paste jar Sanded and pointed medium blue, this baseboard represents the ocean

The ice cake and iceberg are of 34-in three-ply, sketched and sawed to shape, and nailed together with the lower edge of the berg resting on top of the take. As this assembly is binged to the back of the base 2 is well to set to the hinges on the lower sale of the take before earling the two parts together. Also cut a hole 4 in in diameter, over which to mount the igloo-

Turn the snow house from a block or wood. Mount the blank on a faceplate and shape a semispherical hollow in R. Remove mount another block, and turn it convex to





Rayah and paddie, assembly drawings a side view of the kayah and section A-A through it



The top of the kayak can be roughed out quickly with he aid of a bandnew sanding belt if one is available

fit into the hollow. Prem the Igloo block over it, put a screw through the top, and turn the outside

Carve the entrance piece, fitting it against the main section of the shelter. Saw out a smoke hole in the roof, slice off the rear aide to butt against the iceberg, and assemble the marks on the ice cake. Then, to remove the ever the igloo with a plastic wood compo-sion or gesso, sina ching in sungestions of funds between the snow blocks. Modersnow mounds on the ice, rounding them up ento the house, as indicated in the photograph at the beginning of the article

Carve the assak from a pine blank 34 by 1/2 by 51/2 in Curve the top and trace on it a pattern for the sides. These are sawed with considerable underslope, after which the cockpit is bored. The top, gable fashion, slopes from a center ridge to the sides. Drive two brads near one edge to hold the paddle, and had the boat to the base

The paddle may be carved from wood or ground from a piece of back-saw blade, with the handle like an arrowhead, sharpened for opening letters. The puddle and is the hand-

Paint the keeberg light blue with patches of light and dark lavender. The ice cake and igloo are white, the kayak is raw tientawith brown straps across the top, and the paddle is red. - EDWIN M LOVE.

LACQUER BRUSHES KEPT **CLEAN WITH ACETONE**

A clausest for lacquer brushes that may he used in an emergency as a satisfactory and mexpensive substitute for the regulation lacquer thinner is acetone, a coloriest liquid that can be obtained at drug stores. On relatively unimportant work it can also be used as a thinner for cellulose lacquers provided one part of amyl acetate is added to every five parts of acetone. Brush marks on bequered work can be removed by spraying with acetone I have also found that accione makes an excellent quick-drying thinner for ordinary shellac .- O B.

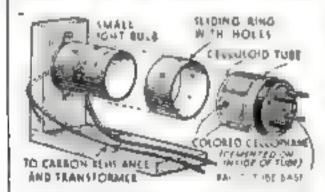
Simple Microscope Lamp Gives Wide Range of Light

By H. J. SEXTON

An effective microscope hmp, which has an adjustment for various light intensities and a choice of numerous light apertures and several color filters, can be built from the base of a burned-out radio tube, a metal socket for the tube, an adjustable carbon resistance a 10-volt bell migrag transformer, a 6.3-volt radio panel-lighting bulb, a serow base for this lamp, a piece of transparent celluloid, small strips of variously colored celluloid, small strips of the hardwood or bakelite, some insulated electric wire, and a socket plug. About half a dozen small bruss bolts and nuts such as are used for radio work are also required.

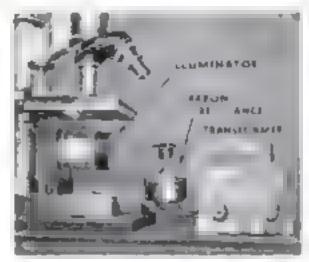
The piece of hardwood is cut into two parts. These are fastened together with three acrews at right angles to form a support for the lamp. The support, when assem-bled, must be of such dimensions that it will just fit under the microscope stage. To the upright part is affixed the radio tube socket, the screw base for the small lighting bulb, and the necessary insulated wiring for the lighting circuit. The adjustable carbon resistance is fastened to the base by means of a brass strap, and connected in series in the lighting circuit. From the strip of 1/15 in. brase is formed a ring to fit the metal radiolube socket on the outside. This ring is drided in a line around its periphery with various holes from 1/64 in. or smaller to 1/32 in, or larger in diameter. The socket itself is drilled at its highest point, immediately underneath the opening in the microscope stage, with a 14-in, drill. The ring is now placed over the socket. By turning it, various-sized openings for the light can be brought in line with the 1/4-in, hole,

The color filter, which revolves itside the



The parts superated to show how the size of aperture and color of light are controlled

buib, is made from the base of a radio tube, a piece of transparent calluloid, and several variously colored strips of rellophane. The glass of the radio tube is broken, and the bulb hase sawn off about 14 in. from the prints and. A cylinder is made of the truepurent celluloid and cemented to the sawaoff tube base, Narrow strips of the colored cellophane are remented with Canada balsam lengthwise inside this transparent cellsloid cylinder One section, however, is left uncovered to provide a white light. The cylindrical color filter, when assembled, must fit inside the metal radio socket. The projecting prongs form a handle for revolving the cylinder, bringing each of the color 6) ters in succession between the light bulb and the opening in the outside ring. The lighting wires are now connected to the 10 volt side of the bell-ringing transformer, and the 120-



This microscope lamp in easily adjusted for light intensity, polyr, and uses of aperture

volt side of the transformer is connected to the house lighting circuit, by means of a socket plug.

Adjustment of the light intensity is obtained by operating the carbon rheostal Adjustment of the light aperture (or irin) is obtained by revolving the brass ring on the metal radio-tube socket, and either a colored light or white light is obtained by revolving the cylindrical color-filter bolder taside the socket

It will be observed that the voltage on the output side of the bell-ringing transformer, 10 volts, is greater than the small incandescent built capacity, 6.3 volts. This is necessary to bring the built to full brilliance but the circuit is always used with some resistance in. A flashight built of from 15 to 4.5 volts may be used when connected to a dry or storage battery, and satisfactory results obtained

The instrument, when acientifically constructed, furnishes a method for standard using light intensity under the control of a calibrated rheoutet. Light aperture and color density from standardised filters are determinable factors that enable various observers to obtain similar light conditions

METAL DECORATED WITH FUSED GROUND GLASS

By PUSING particles of colored glast on small metal parts, they can be given a permanent, hard finesh resembling andboos of tiny jewels. The best glast for the purpose is annealed tubing such as that used for themical experiments and making neon signs. Grind a few pieces of the different colored case in a mortar until it is almost pulverlied, it may then be sifted through were gauge to remove any coarse particles.

The article to be finished should be sufficiently beavy so that it will not bend easily it must be well cleaned of grease and foreign matter and then coated with a thin film of ordinary water glass (sodium silicate solution). The powdered glass is immediately sifted over it thoroughly and allowed to day

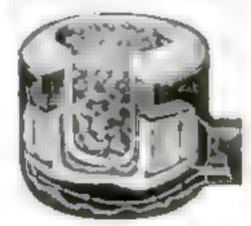
For the lusing process use a burson burner. The larger it is the better. Hold the prepared object directly in the flame by means of phers or tones and keep it moving unti-all of the glass has partially fused totether and the low sharp pieces appear smooth and rounded. Remove from the heat very gradually to allow the metal and glass coating to cool at the same rate of appead otherwise the glass will chip.

The process has many variations and applications it may be applied not only to metal, but also to giass vases test tubes, tubing and other surfaces that will withstand beat. Designs in colored glass may be formed by painting them on the object with water glass and covering with the desired color of powdered glass. The treatment is repeated with different colors, and all are fused at one time—E. M.

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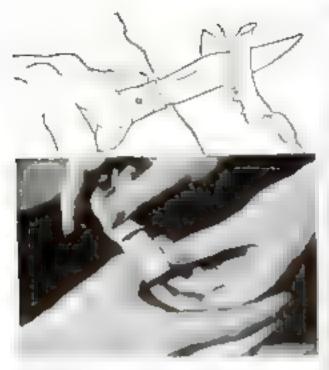
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Construction Kits

NOTE that you list a number of blueprints for ship models. Making a ship model is a hobby that would appeal to me, but I do not know which one to try first. What do you recommend?"

This is one of innumerable similar questions asked by readers. By far the best way to get started in ship model making is to buy one of our construction kits. These contain all the necessary raw materials as well as the full-size blueprints. There is a great advantage in this because it is an exasperating and discouraging job for a beginner to find suitable materials (or making a model. A number of different items enter into the construction of even a simple model, and some of them are difficult to obtain, orpecially in mull quantities.

The easiest of our models to make are the Manhattan, the Indianapolis, and the Sea Witch. These are very small and require few took beyond a pocketknife, a few singleedged razor blades, and a pair of piters. Even boys of thirteen and fourteen can make the arst two without defaculty

From one of these simple models, the beginner can advance to the Spanish guileon, the Revenge, or the battleship Texas Finally for the ship model maker who wishes to build a model that will be worth several hundred dollars when finished, either the whaling ship Wanderer or the aloop-of-war Hartford may be chosen

Those who wish to take up furniture construction will also find there is no better way than to begin with our furniture construction kits.

All kits are accompanied by instructions or blueprints. The list continues on the following page.

A. Whating Ship model Wanderey, All the raw materials together with Blueprints Nos. 151 to 154 and booklet. The hull is 2015 in. long

AA. Same with hull lifts sawed 7.40 D. Spanish galleon ship model, 24 in long. All the raw materials (except paints), Blueprints Nos. 46 and 47, and a booklet 6.45

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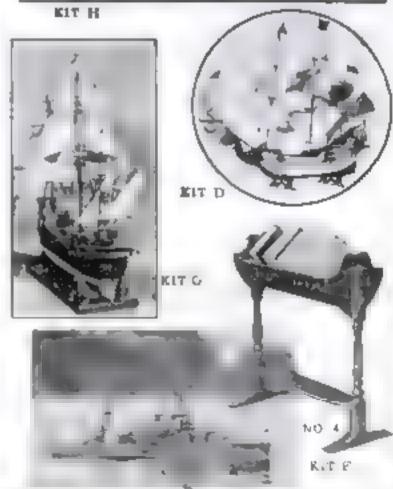


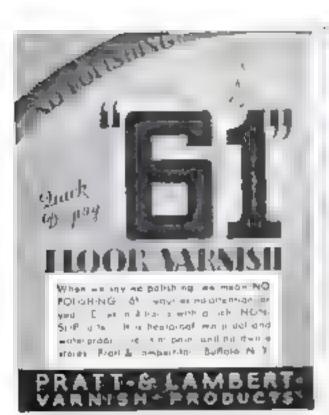
The lasteric Hartford-KIT L



K. T. F.- Materials for 17 in. model of Manhattan







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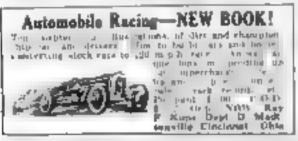
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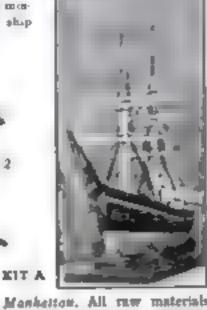


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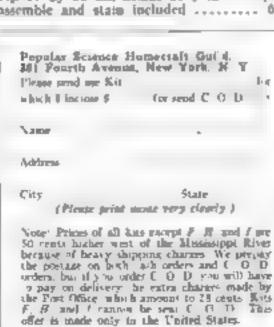
G. Elizabethan galleon Revenge. All raw materials (except points) for a model 25 in. iong, and Blueprints Nos. 206 to 200., 6.75

GG. Same with half blocks shaped. 7-25 H. Cruiser U S S. Indianapolu. All raw materials (with enamels) for a simplified 1. in model, and Blueprint No. 216., 1.50

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n king 9' in wide, and 24% in high over all Ready to assemble, with firming. 5.30 No. 5. Some rock mapie hanging wall make with some drawers 1976 in wide. 11%

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It is very easy to give your bale that rich, glossy and order y as warance so essential to well ground beys. Just rub a it le traistora through your mariners or two e a week for at er shampioning, and your hair will then may, each day, just as you comb it

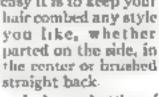
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t dostera also keeps the scalp soft, and the bair healthy by restoring the natural oils from which the hair derives its health, life, gloss and lustre.

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BOTH subjects are exclusive designs by a prominent artist craftsman. They are unlikely new and fashionable and any one of reasonable that can make them with few tools. The Bracelet can be made of sterling aliver or nickel aliver (German Silver), either by sew pleasing the design or by etching It. Directions for both aperations are given. The Bowl, Including Its tegs, is bond hammered from a single piece of sheet copper (no saidering). The Bulletin gives directions for tools required, some of which most home craftsman ciready own.

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Ridge #11



BUILDING TRESTLE FOR MODEL RAILWAY

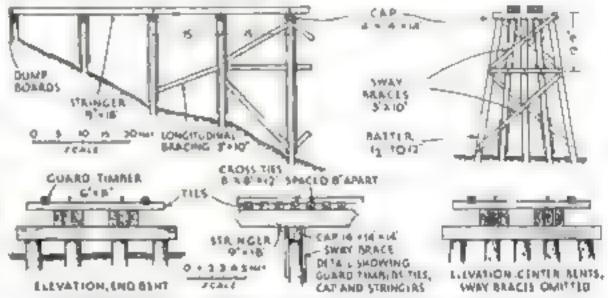
EVERY miniature railroad needs at least one bridge on the system. As our road is in the pioneer stage of construction, the old-fashioned pile trestle will probably be the best type to start with. True, these structures are obsolete on an up-to-date main line, but they make a model more picturesque and will be entirely appropriate so a branch line or "mountain division."

Dowel stacks are the most popular material for the piling, but a more realistic effect may be obtained if small, strught willow branches are used. The branches should be peeled and thoroughly dried. And don't forget that the small end of the pile goes down. Sway braces and longitudinal bracing may be made of wood or cardboard. Note that the sketch shows two sets of three 9 by 18 in. stringers

at each side of the trestle. It probably will be more convenient in making a small-scale model to substitute one solid strip for each set.

The leasth of the trestle has not been shown on the drawing for the reason that as many 15-ft, spans may be used as desired. The dimensions given are all full size, and a scale in feet has been provided so that a model can rosily be built to any desired scale, depending upon the track gage of the railway. The dump boards at the end of the trestle are usually secondhand timbers of any size, provided, of course, they are sufficiently long to hold the embantment away from the end bents.

The whole structure should be finished with a silver gray stain to give it a weathered look.—I W Cikhtant

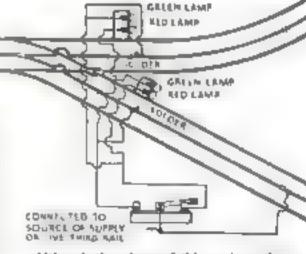


These drawings show the casutruction of an actual creatic such as the one in the photo and the full-otes demansions are andrested. From these a model can be built to tend

A SAFE WAY TO WIRE MODEL SWITCHES

Ox say model railway system a number of accidents occurred at one of the switches, and finally a car was remed. I then installed the wiring shown in the accompanying diagram. This is an economical method of preventing accidents and adds realism to the track layout.

One wire is connected to the green lamp on the first track, which, of course, must be availabled or isolated, and to the third rail of the same section, and also to the red lamp on the second track. A second wire councils the red lamp on the first track and the green lamp on the second track, and runs to the isolated third rail section of the second track. He sure that the isolated sections are long enough to let the train roll to a stop before it reaches the end of the section. For my panel board I use a single-pole, double-throw switch — Langar Banks.



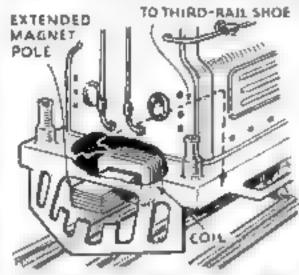
Although the wiring of this model so Iway so the looks comporated, it is quite casy to install and makes accidents imposs ble

RUBBER BANDS REPLACE SCREEN-DOOR SPRING

A coop substitute for a long colled screendoor spring can be made from several large righter bands out from heavy tize inner tube, looped together end to end. The rubber bands should be at least ½ or ¾ in, wide. One end, of course, is secured to the screw eye or book in the door, and the other to the door casing. This arrangement is absolutely quiet in action, and the rubber does not damage the door.—R. R. RUNDELL

MAGNETIC COUPLER FOR MODEL SWITCH ENGINE

A MODEL switch engine built by the writer has, as a novel feature, magnetic couplers Which operate automatically Such couplers will not, of course, handle heavy trants, but switching operations may be curned on in a realistic manner with single curs. or with two tars coupled together. The system is best adapted to electric-type locomotives having remotely controlled reverse. The



Model locomotive with a magnetic coupler that works quiomatically for switching core

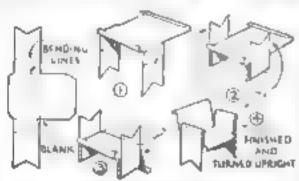
regular coupler may be retained at the rear end, and the magnetic device installed in front

Sufficient space must be available to mount a small electromagnet between the motor chause and the pilot, with the pole piece projecting through the upper part of the pilot If the latter is of sheet metal, the required opening can be cut without difficulty The magnet may consist of about 300 turns of No. 28 enameled were wound on a lamorated core of tin or transformer from For an "O" page lucomotove, a suitable cross section for the magnet core is 14 by 14 in. One end of the winding is grounded to the frame the other connected to the third-rail roller

The coupling is accomplished when the pole piece makes contact with the coupler of a car. It can be released by culting off the power while the engine is pushing the carso that the latter coasts out of range of the magnet.-CHARLES D. SAVAGE

MODEL PULLMAN SEATS MADE IN ONE PIECE

THE model rational haster who cona big job to make the scuts. The aketches below show how I cut and bend the seats from sheet metal. Each set is made from one piece and painted neatly. The sharp points at the bottom are driven slightly into the



A simple method of cutting and bending miniarura seata for use in a model Pullman car

floor and hold the seat firmty. It is best to make a pattern very carefully from thus tin so that it can be had down and marked around. I cut the metal in 354 in. strips, which is correct for seals for standard gage curs. For "O" gage Pulimans, the stock would be smaller.--- llovo J McWnoema.

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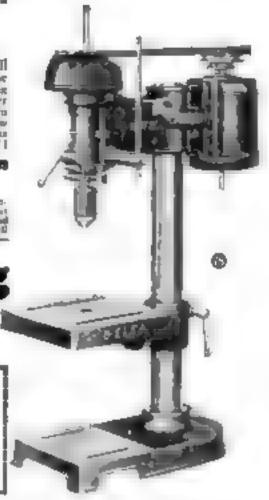
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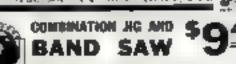
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THE NATIONAL HOMEWORKSHOP GUILD

[Continued from page 601

WHAT IS

Your Club

DOING?

Securitaries of local home workshop

clubs should report all interesting ar-

tivities to Guild beadquarters. Sent

in notices of special programs, demon-

strations, and addresses. If the mayor

of your town, a leading surgeon, or

some other prominent man joins your

club, that is news worth publishing

Mail all such notes promptly to E.

Raymond DeLong, secretary of the

National Homeworkshop Good, 312

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tracts from these reports will be pul-

lashed every month in the Guild col

umm of Popular Science Monthly

both amateur and professional mechanics, this method of furthering the movement should be helpful both to those who wish to organize a club and to those who cannot spare the lime to do that but would like to join a club when one is formed in their neighborhood. Pay a visit to your hardware dealer and talk it over with him. He will be able to tell you if a club is being formed in your locality and will have other information of importance

"Hardware Age," leading magazine in the hardware trade, has actively helped to arrange for the cooperation of hardware dealers and has published a comprehensive article about the purposes and advantages of the Guild. Through "Hardware Age" and the hardware dealers, it is hoped to reach many amateur craftsmen who otherwise might not know about the formation of the Guild.

One of the new clubs, the Peekskill Homeworkshop Club, of Peckskill, N. Y. mustered aspeteen charter members at its first meeting and the Aris and Crafts Club at Menomonie Wase, reported that fifteen charter memhere attended its organ salion meeting

Other clubs previous y formed also notified national heat-quarters of the addition of new members. Except for the original club at Rockined, the Topekn Homeworkshop Club, of Topeka, Kans., now has the largest member ship with thirty one on its roil, but several clubs are creeping up on it

The Topeka Club played Santa Claus at the Shawnee County Parental

Home and distributed fifty toy airplanes. doll beds, wagons, and other wheeled toys This club meets at the Chamber of Commerce in Topeka and has had informative demonstrations on craftwork by Fred Jepson and A W Larson, industrial arts instructors in the Topeka public schools. The members have already made tentative plans for starting the production of toys for next Christmas so that members can work on the projects whenever they have any spare time through

The Amarillo Homeworkshop Club, of Amanilo, Texas, cooperated with the local fire department, which annually collects and repairs old toys for Christmas distribution. Club members made about 100 new toys to be added to the ones repaired by the firemen. Wives of the members prepared the mattremes for the doll cribs, the material being supplied by a mattress factory. Some of the small mattress covers were decorated with a beautiful design, the work being done by a printer who belongs to the club. Waves of the members also dressed tweaty-five dolls which are not shown in the photograph on page 69. The lumber used for most of the toys was taken from apple boxes. The guns shown at the top of the photograph shoot rubber bands made from old inner tubes. To make so many toys in such a short time was a remarkable demonstration of industry and enthusiassa on the part of the dub members.

The Macristown Homeworkshop Club, of Marristown, N. J., held its first meeting in the home of K. C. Bates, the secretary, and its next meeting in the local high school, Harold Eaton, an instructor of craftwork at the high school, is one of the members of the club This club was one of the first to prepare printed stationery of its own.

The Guild, in its various bulletins, has not offered suggestions for the stationery of local clubs, but it is obviously a great advantage for a club to have a neat letterhead for all official correspondence. The Guild is having line cuts (engravings) made of the official seal as it appears on its own stationery, These can be obtained by the local rlubs at cost from national headquarters. The use of the seal with plain, neal type and a good quality of paper will make a club letterhead of excellent appearance.

E. Raymond DeLong, secretary of the Guild, has answered a number of new ques-

> tions. One that is asked repeatedly is: Does the guild recognue all branches of homecraft work? The answer, of course, is yes. He has stressed the fact that diversified hobines in a club are to be desired as they el mulate |nterest. are educational, and appeal to the true humecrafter, who is usually enger to pequite a knowledge of craftwork other than his own partieular hobby. Many a man has tried only one or two specialties in the home workshop field and and he knows more about the hundred and one other branches he cannot be sure that he has chosen the particufar type of work

which will give him the most enjoyment Some requests are made for recommendations as to the best brands of tools and equipment to be purchased. As the Guild is ent rely noncommercial, it can make no special recommendations. Its attitude in regard to manufactured products obviously must be one of complete impartiality

It should be repeated that clubs may be formed in Canada for afflication with the

Since the March issue went to press, the tollowing clubs have been organized

Antioch Homeworkshop Club, Artioch Cabif.-R. H. Cameron, president; Mott Pridgen, secretary B. L. Jackson, treasurer Arts and Crafts Club, Menomonie, Wisc -Harry A. Beach, president, Norman A. Jensen serretary, Hartvick J Dotseth, treasurer Billings Homeworkship Coch. Brings. Mont .- Thomas A. Purcell, president; E.lis Blandall, secretary; Cecil Fartle, treasurer, Bristol Homeworkshop Club, Bristol, Conn -- John Wilson, president, Reginald C. Mor-

refl. secretary, Dr J S Wilson, treasurer Cheyeane Hobby Club, Chryeane, Wvo.-William F Winkle, president; Edward L. Kopp, Jr., secretary-treasurer

Craftsman's Homeworkshop Cinb, St. Louis, Okla,-E. W. Pearce, chairman, John H. Gilmore, vice chairman, Bruce McClaffin, activitary treasurer

Eastchester Homeworkshop Club, New York, N Y.-John LaRussa, president, Anthony Nicosia, (Continued on page 101)



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HOMEWORKSHOP GUILD

Con taked from page 1001

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Warren Homeworkshop Club, Warren. Objo-P W Busefink, president; M. H. Post, secretary, John Finta treasurer

Requests for information in regard to form ing local clubs have now been received from every state in the Union and from Canada Hawan and Porto Rico, If you wish to know more about the Guild, fill out the coupon below and send it in

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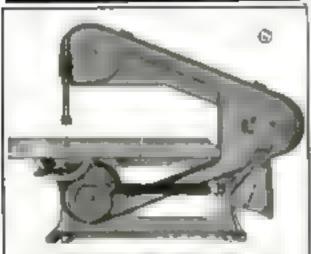
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MASTS AND SPARS FOR THE HARTFORD

(Continued from page 71)

boom hanes from the bowsprit cap with an eve boit It is thickest two thirds of the way down. It has two clear bands and an eve hand at the end. I made the clears by flattening a piece of wire and working it through the boom, turning each end down at a right angle.

The spritsal yard or spreader for the boom go s is a round spar tapered to both ends, with shoulders for the guys. It is slung under the bousprit, between the botstay deadeves with a wire parrel.

The fore and main spenory gails are thickest one third from the mast. I made the goosenecks by landing the ends and drawns in bent pans. The spanker gail is similar but longer. They are the natural wood color with white

The varie are all of the usual shape, purashel in the first quarters and from there tapering to the variarms where there is a shoulder and then a sharp

The lower yards require trustes. The arms of these I made from Xo. 18 copper were the energy vertically in the middle and horizontally at the ends. The ends are soldered in bands to fit the sard. The middle is dolled for an escutcheon pin, the end of which is drilled to take a par through the hims on the mast hand. Right amidships there is a band with the sheet sheaves underneath and a bolt for the chain sling above At the ends are spider bands with three coes above, henceth, and about

I fixed all my yards with Jackstays. For three I used No. 32 semihard black steel ware. I made the holts or staples to hold them from the same wire, doubling it sharply over piers, drilling small holes, and driving them in part way, then receing the

LENGTH AND GREATEST

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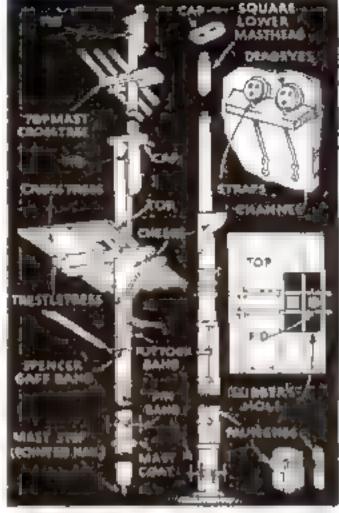
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Sketches showing how the mests are set up with tops, cops, and other fittings; also the deadeyes

wire through and lapping the staples have I find that footcopes (horses) and stirrups made of cord will not keep in position so made thrm of No. 32 covered magnet wire. These are fastened to the bolts at the yard-

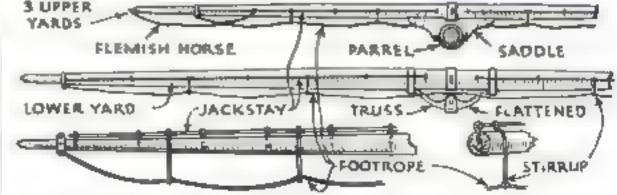
arms and a the parents a Note that as the yards decrease in size, the arrangement of the footropes varies.

The toposit yards have twoeye eyebolts at the ends, a band and eye in the mille for the ha tards are a sadore are parrel to keep them, a the mast. The sad le is cut to shape and belted to the yard, and the parrel is made from thin brass, drilled to take the pinheads which are used later to bolt it to the saddle. All the yards are painted black

The shrouds are topmast backstays require a 1-m negatives the topics and backstays, 5:32m; and the royal year. Strap them to the chain plates in any approved fishion.

hasten also two readeves to bolts in home mast, and put two bolts in the deck ast about the maintast for the mazen stay

(Lontoneed on page to3)



Top views of a typ tel upper yard and a lower yard and a view of part of a yard as if some from directly aft. Note also the sketch abowing relation of jackstay, starrup, and footrops



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MASTS AND SPARS FOR THE HARTFORD

Continued from page 1027

I found it best wherever a deadeye, block or line had to be bolted to the deck, in fasten it first to the bolt and then, after drilling a hole, to drive the bolt in

Before placing the musts, I drave a pail in the end of each so that it would go into the bottom of the bull.

Most coats should be placed around the masts where they come out of the deck to cover the joint. These are rings about 3/32 un in section, rounded on the outside and fit tang tightly. I made mine of white celluloid. but any solid or plastic material will do

Fix the masts in position and make the tops to go on them. These consist of fore and aft battens catted trestletrees into which

the crosstrees are half-lapped

On the crosstrees is placed the floor, which is cut out as shown to take the masts and allow space to pass the rigging through. This in called the "lubbers hole." In the outside reget, the fore and main tups have four slots for the topmast-shroud deadeye straps, At the missen only three slots need he cut. Glue and nail the trestetzen above the cheeks which are firmly holted to support them

Next comes the bowsprit. Put this in its hole and pass the gammoning lashing over it and through the holes in the stem. You may need the belo of a thin wire to do this. Set up the bobstays from their strage on the stem to the deadeyes under the how sprit Chain of from 12 to 14 links an anch is suitable. Also set up the howoprit shrouds to bolts above and about the howse pipe Strap two 3/16-in, deaderer about 16 in apart from under the howsprit, allowing enough clearance for the jib boom to puss through the straps. These are for the fore

TO BE CONCLUDED.

Prizes for Second Photo Contest

I'V THE second of our winter se ries of indoor photo controls (1) S. M., Dec. '35, p. 68), the following prizes have been awarded

FIRST PRIZE, \$25 Augusta Strumpen, Philadelphia, Pa-

SECOND PRIZE SIS E P Fleming San Dirgo, Calif

THIRD PRIZE, \$5 John R Schnek, Findley, Ohio

FIVE PRIZES \$1 Each

C W Smith Belleville Ont Canada Mrs Erwin E Velson, Ann Arhor, Mick Fred M Fling Alla dena, Catif Mr., Rumon E Kex ser Son Frontino, Calif., Paul Cal. licotte, Portland Ore

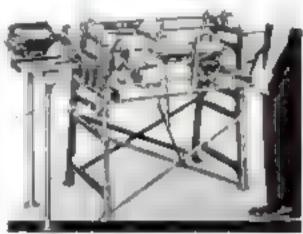
HONURABLE MENTION-D. B. Cartweight, Menomone, Wis ; Lloyd ertsoright, Sagmara, Mich., Alice Caton, Knoxvdle, Tenn Tale B Griffith, Los Angeles, Calif., Carl T. Julien, Celo, N. C., Louis C. He Vutt Beooklyn, N. F., Mary Weight Pridham, West Palm Beach, Fla Adrian M Savage, Millers Falls, Mass, and Lewis Stories, Duhman Wash

Winners of the January contest will be unnounced next month

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BE A DETECTIVE WITH YOUR OWN MICROSCOPE

(Continued from page 43.

average amateur microscope usually are used and the preparation of test smears is an inroived process. However, the duty owner or farmer who wants to control the quality of milk and detect trouble at its source. might profit by a study of the subject

There are scotes of other foods that you can submit to the relentless eye of your microscope. Bread, bits of meat, cereals teaand many more will provide countless thriftas their wonders are revealed. In audition, they will be revealing to you their secrets of purity or impurity, and the other qualihes that enable you to judge their worth

THE general method of preparing foods for microscopic examination is to reduce them to small particles and perhaps mix them with water to form a paste. Thus tapiora starch is prepared by placing a few drops of water on a half-dozen grains of tapioca and crushing them (not too severe by I with the back of a spoon. If the starch is being treated with lodgie, the lodged water can be used to moisten the coarse tapinca grains. Do not use too strong loiling or the grams will be too densely colored

One of the most valuable uses of the macroscope around the home is the mamination of fabrics. It reveals at a glance whether your shart is wool, cotton, linen, silk, or rayon. Before it can do this, however, you must make yourself familiar with the appearance of these substances when magnified 100 or more diameters

Wool cloth is made from the bair of some enimal, usually the sheep. A hair has a definite structure and each animal produces a characteristic type. If you are familiar with the appearance of many hairs, you can stlentify the animal from which each comes That is the method often used in commal investigations.

But your suit or shirt is not a criminal, so you are concerned chiefly with the question of whether it is made of animal hairs or vegetable or animal fibers. Obtain a piece of wool-material you know is genuine wood and nothing else-and separate a few of the and strands from one of the individual threads. Place these under your lenses. An undyed hair is preferable for study. The hair, when sharply focused and properly lighted, looks like a shingled rod. If you slice it in two, at an oblique angle so that it is virtually split lengthwise, you may be able to see the inner structure. There is a central core or medullary layer of rounded cells. Around this core or axis is the curtex made of flattened, clougated cells. Dutside are the overlapping, shintslebke plates or cell-It is the interlocking of these sharp-edged projecting plates that makes the wool filters adhere together to produce a cloth of great strength and wearing quality. Once you have made yourself familiar with wool, you can not fail to identify it wherever you find it

MITTON, likely to be found with wool an rioth that is not all wool, looks like a mass of twisted ribbons under the macroscope. Each cotton strand is composed of cellulose covered with a thin skin. Along the center of the strand is a canal. If you can shift a cotton strand about until the end is seen in cross section, you will find that the torm is like a crescent moon or an ellipse Twisting of the cotton fibers is perhaps the most outstanding feature by which they can be identified at a clause

The other important fabric material origmatene from a plant is flax from which lines is made. A flas strand at one time was a bast fiber in the plant, that is, a fiber that grew

on the unner side of the bark. The flax fiber, like that of cotton, has a canal along its center, but the cells making up the fiber can be

The two silks, real silk and rayon, are as unlike each other as day and night, when seen under the microscope. Artificial silk is made by squirting tellulose in solution through fine nousles to form long, even aranda that are combined into threads. A typical rayon fiber looks like a jointless rod its surface generally is marked with parallel lines, perhaps put there by the edges of the the through which it was passed. Buyon itbeen are larger in size, in some cases, than gentine salk or other fabric materials

PERHAPS you will be surprised to disteact structure. The adawarm, in spinning the glutening thread from which its cocoon was formed, used two sets of glanch. The two spinberets of one set each produced a sinple, fine strand of Mac. As these strands emerged, they were brought together and cemented by a substance from the second et of glands. Perhaps the stakworm ione agalearned the secret of the stranded cable and its giraler strength when compared with a solid rod of equal size. Anyway a strand of genuine silk toks tike a rod or cord w h a central canal or partition running through it. The surface of a silk strand may not be perfectly regular, but marked by occasional ragged projections

After you have made yourself farm ar with the important textile raw materials, and have analyzed all the cloth in aight, you can have a lot of an examin or papers and determining their origin burs, of a make y stated familiar who would and steam fihers Paper in composed chiefly of wood, straw, linen, and cotton fibers. Newspapers are made of wood, fine writing paper of

hace or cloth

To prepare paper for examination, lear it ento small pieces and bull it in a weak to lution of lye (caustic sode) until you have a pulp. This process frees the fibers from the filling and string materials. Wash the pulpwell in clear water, and with the microscope examine a portion of it either in the wet or dry state

You will see, on some of the fibers taken from the paper, rows of round or avail pits or pores. You may be able to make out destinctly the led-vidual cells, and observe that some are long and others short. The fibers. for the most part formerly were filtro-year catar bundles in living trees, and the pits or potes you see on them were involved in water circulation through the tree

HE habit of examining everyday objects is one that may prove of real value to you. By detecting a fraud-perhaps by discuvering that a suit for which you paid an all-wool price really is half cotton-you may save more than the cost of your microscope

You can have a lot of fun klentifying various kinds of furs, although you probalife will run into difficulty in obtaining authentic standard specimens. The famits cat, funior's pet subbit, and the loca- are passarde sources e Compartison Apers mens. Another important and interesting field is the examination of furniture woods Laually you will have no trouble in removing a small sample from some obscure part of a chair, table, or cabinet. The microscope is the easiest and sometimes the only way of positively identifying a wood. (P.S. M., Dec. '33, p. 44.1

By employing Continued ou page 105/

BE A DETECTIVE WITH YOUR OWN MICROSCOPE

(Continued from page 104)

dark-field illumination, you can see things through your mucroscope that otherwise would be invisible or indistinct. To appreciate the advantage of the dark-field method, where the object itself seems to be emitting light against a black background, turn for a moment to astronomy. The stars are in the heavens in the daytime the same as at night, but you cannot see them because their feeble light is blotted out by the brillman sky At night the sky is black, the pupils of your eyes are dilated to admit more light, and the stars and the moon are clearly visible

O VIEW objects agruppe a dark field, ar-Trange the illumination so that no thir of light can pass into the microscope objective directly from the source of illumination One way to accompash that is to place the illuminator above the level of the microscope stage, so that its rays strike the object from one side. Another way is to place it below the stage but to one aids so that the rays pass obliquely through the object shile but do not strike the sens

You can use the substage marror to produce satisfactory dark-field effects. Often by emply tilting the mirror until the light beam barely grazes the object and muses the lens entirely, good results can be obtained. Swing ing the mirror to one side, so that the beam is still more obtaque in relation to the saide, is necessary in other cases, particularly when higher powers of magnification are used and the objective less is closer to the slide

Many objects which are not perticularly at ractive by transmisted light (bright-field illumination) become things of great beauty when seen against a durk field. They stand out with startling hell ancy because of the granter contrast with the background. Darkfleid Illumination, for instance, will enable you to see the cilia or tiny hairs covering the surface of animals from stagment water

In using the dark-field method, remember that the objects being inspected assist be scattered over the slide so that light can reach them from the sides. Use a low man nification at first, until you get the illumination properly adjusted. Dark field work, and for that matter the bright-field variety as well, is best done is a darkened room Then stray light will not fall on the stage and your eye pupils will be at their maximum openings, it the room cannot be darkened easily, a light shield made from cardboard and placed around the miscroscope or stage, will help. Arrangement of such a shield is arust timed

Suitable objects for dark-field study at low or moderate powers, include the sait grains in butter rotifers in pond or aquarium water, grains of tapioca starch and other starches, parts of insects, and a million and one other things

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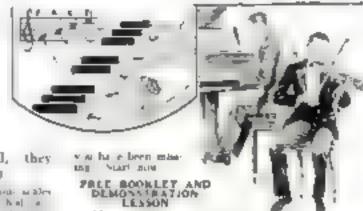
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WHEN Eugene Swold gradunted from high school he incked capital, was blessed with no poliential friends of relatives, and bad no omnipotent pohtical pull, Lake so many others, he ambitiously set about to find a

job, hoping to earn money that he might enter a small tollege near his home the following Fall.

For weeks he haunted the employment offices of the local facturies without surcess. Sto hopeful, he visited relatives in the largest cas near his home and answered want ads for nearly a month Mostly they were ads that deverty cleaked an unfocustive door-to-door selfng proposition, or a project which required capital. Thoroughly discourages he returned home

A few days later he noticed for the tirst time something that he had seen every day for years. He saw that the small tip street markers attached to cornet telephone posta were in a deplorable condition. Formulating an idea, he approached the Chamber of Commerce and city authorities, hoping to interest themin installing new ones. Both groups, faced with defaulting sources of income and curtailed bungets, were cold to his

BtT he had one more idea—an idea based on sound logical deduction. He reasoned that now as never before metchapts facing decreased sales would rely on advertising to restore their normal turnover. So he decided to let merchants. of the city pay for the erection of concreve posts which would serve the double purpose of being efficient advertisements and attractive markers

He set about making a list of the more prominent street corners and solicited the outstanding merchants in the order of their importance, offering them their choice of these locations. The idea of a permanent advertisement for their busmess entailing but one outlay immediately appealed and the fact that they were helping to improve the appearance of the city carried some satisfaction also. Both points were stressed in selling these concessions. Advertisers paid enough to cover the cost of the posts and to provide a neat margin of profit for Eugene. Prices fluctuated with location, posts on the main thoroughfares which were well freexecuted com- (Continued on page 107)



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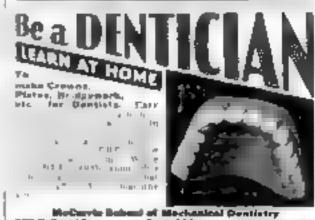
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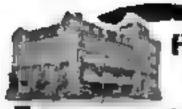
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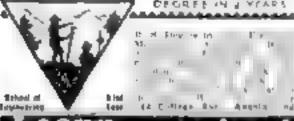
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Secrets of Success Ill send my

STREET SIGN INVENTION PAID COLLEGE EXPENSES

(Continued from page 106)

manding about twice the figure asked for those installed on more obscure streets.

Permission to erect such posts on the boulevards was readily obtained from municipal authorities, since such work fell into the category of civic improvement. This granted, Swold set about maktog triangular shaped posts in a troughshaped mold. The posts were about eight inches wide and three feet long, the length being ample for setting in holes. The upper side of the concrete in the molds was levelled off, and the name of the street and the corresponding subscriber lettered thereon

Neighboring towns likewise were canvassed and markers erected. Bird baths and custom built rock gardens were added to his repertoire as he gamed proficiency

The story ends as it should—in the fall of the year, Eugene Swold bad enough money to enter college -B. B., Ava. Illi-

RUSTY STOVE PUT HIM BACK ON HIS FEET

AT ONE time a wealthy man, as reckoned by may standard. But as the last few years ran their course, mail after mail bad brought hum the discouraging pews that be had been wiped out on bonde bere and



stocks there, and leases somewhere else, until he had only about enough capital left to start in a small business.

He listened with interest to the statement of a real estate dealer that "Blankville was the only city in the United States not hit by the depression." Not only did be listen to this statement but he permitted himself to be tacked into buying a small business there. He soon discovered, however, that the above statement was only a high-powered selling tool, and knew that the sooner he got from under the load he was carrying, the better off he would be.

He had worked ceaselessly for months, for nothing, in the depressionless city Then he sold or rather gave away the business and returned to his home with just about enough capital to keep the wolf on the run for a year. To one past sixty a year is very short indeed. He knew he must get busy at once.

One day as he drove along the street in his car which had been changed from a Binck to a Ford, he was attracted by a large crowd and (Continued on page 108)

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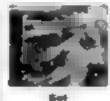
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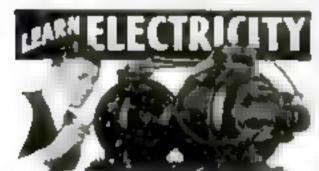
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METAL CRET PRODUCTS CO., Days. E.

Secrets of Success

RUSTY STOVE PUT HIM BACK ON HIS FEET

(Continued from page 107)

the full, deep voice of a wiry little man. calling out, "One dollar, one dollar, do I hear on dollar-fifty? A dollar-fifty, do I hear a dollar-fifty?

A dollar-fifty," Mr. Winn said, another voice added five cents, Mr Winn added another five and discovered he had bought a No. 16, Florence Heater, durty, tusty and in need of a new bowl.

While he stood in the crowd waiting for the rest of the auction, he thought about the possible profits to be made from repairing, refinishing, and re-selling furniture of this kind. He decided to see what he could do with the stove. He paid fifty cents for delivery to his home and although stove parts are very high when he sold the stove a few weeks later for \$10.00, he discovered he had made 100% profit. That gave him his idea

He attended auctions regularly, buying everything needed in the home, garden and work-shop. Rounds, slate and seats, which seemed nothing more than kindling wood, he returned to their natural element -rocking chairs. He rebuilt and refinished tables, dressers and beds

He and his wife did not really need all of their five room cottage, so they converted their large living room into a display room. Then he went to a sign painter and had a sign made which reads

> FOR SALE HERE Used Furniture All kinds, Lowest Prices Your Inspection Invited

Business began, and in the less than a year be has been in business, he has doubled his modest capital -D M, D Jacksonville, IL

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T HIS department will give \$5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

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"get-rich-quick" type of story. Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us argued statements to the effeet that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address con-tributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

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HOME TESTS REVEAL NATURE OF SULPHUR

(Continued from page 57)

escaping into the room. In operation, the bottle of sodium hydroxide solution will be analogous to the scrubber bottle used to absorb thlorine gas (P. S. M., Oct. '3J, p. 50)

The amateur magician who knows his sulphor can change a glass of wane into milk merely by adding what appears to be water The Wine, however, is a solution of potassium permaneanate while the water is colorless hydrogen sulptude solution. The milk will be a white suspension of sulphur formed by the maxing of the two solutions

A smiler trick in which water, milk, port wine, and guiden champagne are poured from the same bottle also makes me of a common compound of sulphur, First, pre-pare the aquid for the bottle. This currents of tenn-sulphate solution, made by dissolving about a tenspoonful of the chemical in a pint of warm water, to which about six ltops of supbaric and are auded. To make the illusion complete, use a brown bottle or a pottery patcher rather than a dear gues-Chillia det

Next, prepare the four wine glasses. It is in these that the trick hes. The first glasswhich is to coplain the water requires no preparation. The logged in the bottle is colorient and resembles water. In the second however, which is to contain the milk, place a small appount of calcium chloride solution. In the third, which is to contain the port n ne place tome potassium permanganate Are totally in the fourth, place a small amount of sodium bearbonate and a few steps of water

He ore showing the trick be were to display the seeming yempt a seek and the life. tle, announcing as 500 proceed exactly what carb glass will come in to the liquid of proceed, it will remain market as I fells she first glass change to a noise liquid in the second become a rest agains in the bird and a good imitation of champages to the fourth.

If in making your first try, you find that the around a sless, add motor or the ran solphate and sulphuric acid to the liquid.

PRINT PAPER MADE OF OLD TELEPHONE BOOKS

SIMPLY by changing the type of lish used in printing telephone directories, telephone companies are saving thousands of delians a month. The use of the new ink enables them to reprocess the paper and use it again. Historia, the chemica is sport carbon parment used in the ink made it demoust to beach the paper for reuse. The new ink contains an or, and from compound which can be torached rasily. During the past two years the phone books of the larger cities between New York and Omaha have been collected and sent to the plants where the paper is bleached, reduced to pulp, and made into new shrets. In some cases, as much as righty percent of the pulp was found suit able for producing high grade white paper of sufficient quality for use in books

NIGHT AIR RICH IN RADIOACTIVE MATTER

Willis you breathe after dark, you take rate your system a third more radioactive matter than when you breathe during the of Washington, D. C., have just discovered that rador a gaseous form of radium, and other radioactive materials are thirty percent more abundant during the hours of darkness. The so-called "respiration of the soil," pouring radioactive matter and parti cles of electricity into the air is believed to account for the difference

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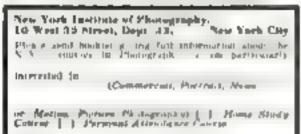
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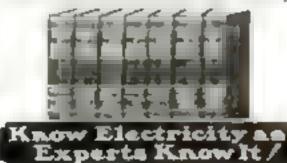
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FASTER AND SAFER PLANES FROM WORLD'S BIGGEST WIND TUNNEL

Continued from page 28

many problems of flight can be solved by full-scale wand-tunnel research. But some of them have been thus solved and in the two years of its existence the big N A C A. tunnel has played an important part in the advancement of the science of aviation

to other buildings of the Langley Memortal Laboratory, there are many other things as interesting as the gigantic wand tunnel Instruments of uncanny ingenuity, machines that do model-making work of marvelous precision, electric-photographic apparatus that takes poctures of fuel sprays in engine cylinders with glass walls at the rate of 4,000 a second, and with a time exposure of one millionth of a second

MURE important than the instruments, and quite as interesting, are the results that the N. A. C. A. scientists have achieved with them.

Startling recent increases in the spend of commercial airplanes are the result of two major improvements in plane design. Among these important changes are

The use of fillets where fuselage and wings,

or narelles and wings, join

bifficient placing of engines in the wings of multi-engined planes, which is considered the most important single contribution to the progress of surplane efficiency aloce flying began

Back of each of these improvements in aurplane design lies much valuable research.

work by the N A. C. A.

Five years ago it was suggested at the National Advisory Committee's annual enminerting tesearch conference with the aircraft industry at Langley Field, that a study of the effect of placing fillets between wings and fuscinges be undertaken. Tests were made on a high-wing cabin monoplane with a slub wing, in the twenty-foot wind tunsel. with an air speed of 100 miles per hour from them it was learned that when filets of sixinch radius were used to fair the lower surface of the wang into the fuselage, the plane's drag of 300 pounds was reduced by two pounds, and that when twelve-inch fillete were used the drag was reduced by a little over five pounds. It also was determined that the use of the twelve-inch fillers increased the plane's propulsive efficiency by about one per cent

THESE advantages seemed small but the N. A. C. A. engineers knew that designers soon would be producing planes with lessened drag, and that then filleting would become increasingly important. So they continued their researches. Last year tests of a low using monographe in the full scale tunnes showed that the use of pheta, as combination with the N. A. C. A. engine rowling reduced the tail buflet by necessations to which this plane was subject to one-quarter of their original intensity, increased the ship's maximum lift eleven per cent, and decreased its min mum drag nine per rent

Decreased drag means increased speed with out moreased power billets which present the premature breaking down of he air flow in the ree of it the intersection of the wine with the fusciage, now are used on all the super fast planes. Experts say that this simple and inexpensive improvement has added twenty to es an bout to the speed of the new est authoris

Most modern large urplanes have been powered by two three or even four engines. Three has been the usual pumber in recent vests-one in the none of the fuselage and two in sengrate bodies, called natelles, attached to the wines.

At the 1928 Engineering Research Conference at Langley Field several manufacturers requested the N. A. C. A. to conduct a series of tests on various nacelle positions.

The Advisory Committee a engineers started work on this problem in the twenty-foot propeller research tunnel. They built a wing with a fixteen-foot span, a five foot chordthe chord of an airplane wing being the straight line distance between its entering edge and its training edge—and a max mom thickness of twelve inches. They also built a four-ninths-scale model of a nacelle in which they installed a detailed wooden model of a radial aix-cooled engine

Testa were made to determine the aft and drag of the wang alone. Other tests determined the drug of the nacelle alone, Then tests were made with the nacelle in twentyone positions in reference to the wing

Without the propeller, it was found that when the nacelle was located above and forward of the wing, the drag of the wingnaidle combination was greater than the sum of the strage of wang and nacelle, while if the saccile was located below and forward of the wing, the drug of the wing-nucelle comhinsting was less than the sum of the drags of the wing and the pacelle

Willif the propeller operating at full power, the wing's lift was increased when the saretic was purced above the wing, decreased when below the wing, and unaffected when directly ahead of the wing

The tests also showed that propulsive efficiency is highest when the propeller is placed

directly forward of the wing

Taking into consideration the factors of lift, drag, and populative efficiency at both high speeds and cruising speeds, and in climbing and landing, it was found that the best all around luration for the nacelle is in line with the wing, with the propeller about I wenty five percent of the wing a chord ahead of the leading odgs. The best results were achieved when the nacello was efficiently cowled, and fasted smoothly into the wing

More than five years ago the N A C. A made a pioneering investigation of the effects of cowling radial six-cooled engines. It proved that a large reduction of drug, resulting to a great tacrease of speed with the same power, could be obtained by the use of a cowling which completely the sed the engine, the cooling air being as metter through an opening in the front and discharged through another opening in the rear of the cause Further research resulted in the development of a N A C A cowling that in 1930 won the Collier Trophy Since then many cowling researches have been made and low-drag cowlings developed that have decreased engine drag by two-thirds and greatly increased speeds

AN AIRINGER carrying a dozen passen-zers and a thousand pounds of cargo at a cruising speed of more than 200 m les an hour seems sensational to-day. But that speed will be commonplace in the near future. The N. A. C. A engineers who have blazed the trail to the present high flying speeds have learned that size has little, and shape much. to do with resistance in the air-that a big plane has bille more drag than a small one

Looking forward, these scientists of flight place the ultimate speed limit at 600 miles per hour before the tremendous drag, caused by every added horsepower will make further increase impossible. That speed would be possible only for straightaway flying, for no human tissue could stand the strain of changing direction at that breathtaking page.





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HOW MOON AND SUN GENERATE THE TIDES

(Continued from page 31)

of the twies when it either remiorces or counteracts the moon's pull.

If the earth had no continents and was entirely covered by water, the two flood tides would follow the moon closely through out the day, traveling at the rate of about 1,000 miles an hour

Bi T. to a matter of fact, the tidal wave is slowed up and modified in thousands of different ways by the obstructions placed in its path by the land masses

If we attempt to follow any particular high tide from east to west around the world's oceans, its progress will be shown by a map something like that shown on the second page of this article. The lines represent the conformation of the high water at hourly intervals, starting in the Pacific

If you count the hour lines in this disgram, you will be surprised to see that it requires forty-right hours for the wave to travel around the world from Asstralia to Alaska. In the meantaint the moon has traveled around the world more than twice (due to the earth's rotation) and its at faction has complicated the original impube with a second and third influence. In this way the tides are consumity variety o interest wave by the changing positions of sun and moon

One phenomenon of the tide remains however fairly constant, and that is that high title comes fifty minutes later each day

It you have stayed at the sea shore for a lew days, you have noticed the length of the interval between high and low water If it is buch tode at ten o'clock in the mornme it will be low tide a little after four in the afternoon or apprea matrix as hours safer Another high tote we occur soon a ter ten in the evening, and another low tide at about half past four in the morning

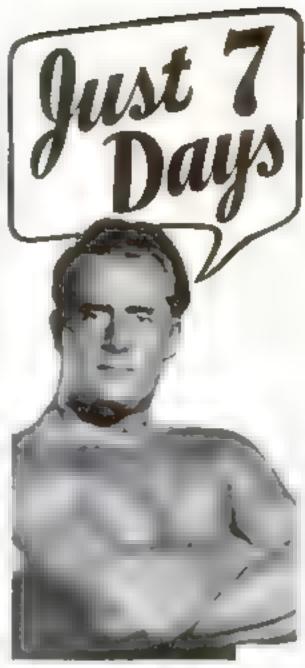
Accordingly, there are two high tides and two low tides in every twenty-four hours, or, more properly in pearly twenty five hours. If it is bigh tide one morning at tena lock the next to it will be high tide at about evelen o clock. In this way the times of high and low tide change through the whole twenty-four hours.

The remon for this daily delay of high and low tides in sample. The moon travels cast through about thirteen degrees, or one twenty-righth of its monthly orbit around the earth, during twenty-four hours. This delays its apparent east to west transit across the parth's oceans by about fifty man utes in twenty four hours. Since the tidal wave follows the moon's meretian passage hs a fixed interval for every place on earth. the lides are also delayed each day

AMONG the many interesting effects of the tides along sea coasts are the remark able rushes of water called bores, which rus up wide-mouthed, rather shallow rivers at high tide. These are often so violent that they are dangerous to river pavigation. One of the most striking bores in the world or cura in the Chinese river on which Hankon is situated, but others occur in the Seine in France, the Severa in England, and the Ganges in India

JUPITER'S ATTRACTION SPOILS METEOR SHOW

JUPATAN is responsible for the fact that in recent years the shower of Leonid meteors is less brilliant than formerly, according to Prof. Wayne B. Hales, of the University of Utah. This planet, he declares, has drawn the meteors from their course, thus preventing their display from being seen on earth



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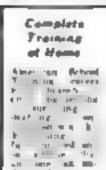
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YOU CAN BE ONE

LIVE ADVENTURES OF TAXIDERMISTS WITH THEIR DEAD ANIMALS

(Continued from page 35)

light, and durable, are now procurable readymade, for the animals most commonly mounted, and are railed manua no They are adapted to the particular specimes with anheure parte of several incredients, and the sky w angers and delicate tools of the taxidermist

A KELEY and Clark also developed a new method of mounting hairless animals, especially elephants. The museum receives from the jungle head, hoofs, tusks, and a sion temporarily preserved where the kill was made and one and one-half inches thick. First it is carefully whittled down to threeeighths of an inch, that the external wrinkles may be more easily reproduced. Then the skin is bark traned, a long process, perhaps a year if there are few skilled hands. Soft and durably flexible, it is stretched directly over the cass figure Next, It is covered with plaster. Then the whole is cut in two the russ due out and replaced with a papiermarke manskin, strengthened speade with wooden take Then the passet is removed, the halves josned.

That is the method Clark employed in mounting the two big giophants added last year to the University of Nebraska's Adam Breede collection of big game animals. It a also the method being employed by some of the staff of n to expetts in creating the most imposing and fascinating collection in the American Museum's Atrican Hall, Housed in the beaut to new Rooses & Memorap adout in to be Maseam building in New York this has will show arming its wills upward of thests separate habitat groups of notable African animals in lifelike poses, in natural surroundings, each against a background na nico ir im actual observation. Clark made her him sie. It many of them, while the camped amid their baunts. A complete model, a bittle gotto is usually made of every such group. The manes of some of the groups tell the dies Linn Groser Waterhole Croup, Nie R er Leoup, Greater Kudu Group, Gunt Eland Group.

This collection of the wonders of Africa, preserved to the life nationals the great rentra piece, the elephants, committing of a herd of eight of all ages Nome with trunks upraised some quiescrot they portray every at an le of the morar h of Atena The first your are in piu e a react mounted by Akeles who is surers ed, the idea before his death The second four have just been received rom Kenya, East Africa, where F Trubee Ogenera. Director of the Museum, shot them. as they came thundering down to trample out the love of his wire and himself

{ ark a newest contabution to tandermy methods is also an elephant-but made entirely of paper. It is not paper-marke, the process is secret, but Clark's studio in the Brong New York has descripted a means to reproduce, seemingly to the life, a big, gray, wrinkled tusker even down to the tusks. Thes are paper too in museum need be ashamed of such a specimen, Clark thinks, and it can be obtained at smaller extense and weighs less, than a real mounted skin

THE studio is also proud of the biggest elephant it ever mounted—the head and fore-quarters of a beast one foot taller than the famous Jumbo, and bigger than Jumbo's recent successor, Khartoum. Each of the tusks weighed over 100 pounds, and was worth \$1,000. The elephant was a trophy last year of Capt. Fred E. Lewis, of Spadra, Calif., who made many presents of

suitcases, belts, and whatnot of the tanned hide from the hind quarters of the biggest of elephants.

Another well-known sportsman and poloplayer brought home from Africa a zebra skin that Louis Jones mounted on a fine prancing hobby-horse, that bore the sportsman's young friends sturdily, thanks to halfinch steel rods inside the wood.

Strange things that come to taxadermistato be mounted enclude antenters, alligators, skunks, rare sheep from Asia. A formidable lask that once faced Fred Sauter, who contimues the art of stuffing begun by his father in 1850, was that of mounting a 1,800 pound hall buttalo, the celebrated Black Inamond. long an attraction in the Central park 200. First, however, he had to kill it,

THIS proved a much more heroic under-taking than Sauter anticipated. Blown from a butcher's sledge hammer and bullets from a police revolver merely bounded harmlessly from Black Diamond's solid skull. An attempt to kill him by hanging resulted only m the destruction of the hosting apparatus Finally a plaughter house attendant got close enough to the old buffalo to slit his throat with a misor-edged batcher's kinde

Sauter mounted the head, tunned the hide, and sold the meat to hotels. They all sent it back, Black Diamond was too tough

There was recently completed at the Cark studio, a piece of work unique in taxidermy the mounting of a giant cay weighing six tons. This strange sea monster, with its twohorned, winglike fins, got caught, off Briefle, N. J., in the anchor of A. L. Kahn's yacht He took it ashore alive and put it on eahibition. It gave birth to a baby my, which died, and is now in the Ph adelphia Academy. Kahn got \$3,000 in ten cent admission fees, and now hopes to make more money by eshibiting the mounted mother my

A somewhat similar job once came to Sauter A man entered his place. With him, was a boy, pale and limping. The man neked

"Can you ax up a shark to it'll look as if it was alive?"

Sauter said he could

"I want you to do it for me," said his caller. "Did you read in the newspapers a white back, about a shark off the Jersey coast attacking a boy? Well, this is the boy, my son. The shark's jaws crippled him for life. He has had a long and expensive illness, and now I'm going to take him around the contro lecturing about his experience We want a shark to take along and cability"

You turnsh the shark " and Sauter " and I'll mount it for nothing "

He made it so lifelike, that at first, it gave the boy the fitters to look at it. But presently, father and son set forth with their stuffed shark, to neck their fortune.

15H, of course, taxidermuts have always with them. Else how would so many American dining rooms get those efficies of bur trout? Small tundermists thrive on fish. which they mount without extracting the oil, and deer-heads, which they stuff with

In one studio, they had to cut a hole la the floor for the neck of a sixteen foot girafie, and men worked on the same animal on two floors at once.

Among the queerest animal specimens mounted in the American Museum, is a group called Solenodon paradoxus. It shows two animals, resembling a cross between an opossum and the (Continued on page 113)

Strok II.

LIVE ADVENTURES WITH DEAD ANIMALS

(Continued from page 112)

sandvark, beloved of cross-word possiers Of one, the whole body is shown; of the other, only the head and long proboscis peep from a hurrow.

The hunt for these specimens brought only a Solenodon and a haif. The quaint animal, starvival of a primitive type, was considered extinct, and a Russian museum had the single specimen in the world when Dr. G. Lagar and A. Hyatt Verrill got these. To do it took a brush with Sunto Dominican revolutionists, much quining, and months in the jungle whence Verrill returned grant, bearded, with one entire specimen and part of another. Also, he reported that this Ireak of nature roots like a hog, has claws, cats snakes, chickens, and bedbugs which it searches for in houses, comes out only at might, runs sideways, and when pursued, trips itself and tumbles bead over heels. Then it stacks its head into a hole and is captured without a fight. The female, shown whole in the museum, gave birth soon after capture, to three naked young, and three days later died.

"HOUSANDS of people take pets that have died to taxidermote for mountaing These include dogs, cats, birds, and monkeys. But there have been occlots, garter-snakes, and the pet horse of a movie actives. Almost all ask that their former companions be preserved in some favorite pose of life, head on one side, ear cocked, or a wag put into a pet poodle's tail. Occasionally, they want the animal's body embalmed for burial

There is real fun in doing jobs for the movies, as many taxidermists do. They started in the early days, when enthudastic directors sometimes had stuffed Bengal tigers stalling the Maine woods. Soon they began consulting taxidermists. One assignment they gave Sauter, was producing 200 sats that would follow a Pied Piper of Hameun, He got the rate from ret catchers, mounted them, and supposed each with an invisible wire to be hooked up with other wices. The day he delivered them at a Long Island studio, he turned some loose among the feminine extras-with satisfactory results.

How movie tandermy has been perfected, is shown by the hippopotami that, in a current picture, readstically raise their heads above the surface of a river, then lower them. The heads were mounted and waterproofed

at the Clark studio.

An odd Job is making planter casts to illustrate street ranway accidents for lawsuits. The casts show the rail, cobblestones, and other surroundings so they can be explained to a jury. By-products of taudermy are leather articles, screens, lampshades, elephantfoot umbrella stands, and other useful things.

PERHAPS the highest flight of modern taxidermy, is treating animals that never lived. An English see captain asked Sauter to make him a mermaid. After some cogitation. he took the lower part of a large codfish, and the upper part of a lady monkey, mounted them, and sewed them together. Having provided the mermaid with an elegant tail, he crowned her head with long, wavy locks made from a borse's tail. To give her a beautiful face and other finishing touches, he called in Carl Rungeus, well-known and mal painter. Then be put the finished product in a glass case, garnished with seashells. The captain was tickled to death.

"Wait till I show this to my landlubber

friends !" he chuckled.

Sauter was tickled to death, too.

"Guess 1'll make some more mermaids,"

He did, and sold them to side shows. Perhaps you have seen one.



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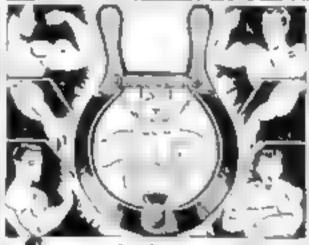
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SHORT-WAVE RECEIVER TO TAKE ON TRIPS

(Continued from page 63)

rear. This position was chosen to eliminate long power leads

As shown in the photograph, most of the wiring is concealed under the chassis. Keep your kads as short as possible and follow the wiring diagram carefully, checking off each wire as the connection is made. Make the socket connections first and then follow with the others.

The cabinet for the receiver should meanare approximately five and one-half inches deep, seven inches high, and ten and one-half inches long. It should, of course, he large enough inside to take the assembled chaosis and tube shields.

On the front of the cabinet there should be four holes for the control shafts and a grill work for the speaker. Metal escutcheons, lettered from zero to one hundred, should be mounted under the tuning dials

When the set is completed, connect it to a reasonably long antenna and mourt the power plug in any 110-volt receptacle. Naturally, when a direct current supply is used, the plug must be inactted properly according to polarity, so, if the set fails to operate after several minutes, simply reverse the plug

To tune the set, insert the proper costs for the hand to be covered and manipulate the dash of the two tuning condensers. These should be turned together so their positions match. The regeneration is controlled with the resistance Re and the small variable condenser Co, the latter being particularly une-ful when tuning in C W (continuous-wave) stations. Remember that the dial-twisting type of tuning that brings in stations on your broadcast set will not work on the shorter waves. Tune the set carefully

List of parts for the short wave receiver follows. Letter and number refer to diagram on page 6?

764

1-140 mmf variable condenses 2-140 mmf variable condenser

5-50 mm(variable condenser C 4-1 mml fixed condenser.

5 - I minf fixed condenser

5- I mmi faxed condensee

?-20 mfd. midget by-pass condenser 8-20 mld, midget by-pass condenser

9-1 mld fixed conferner

CID-4 mid. dry electrolytic condenser) one C11-I mfd. dry electrolytic condenser

C12-12 mfd. dry electrolytic condenser) case C13-000) mfd. fixed condenser

C14- 007 mld fixed condenser C15-Ol mld fixed condenser

C16-Ol m. il fixed condenser

R 1-350 ohm resistor R 2 4 metalina resistor

R 3- 100,000 ohm resistor

R 4- 40,000 ohto resistor

R 5- 100 000 ohm resistor R 6-100 000 ohm resistor

4 000 ohm resistor

R 8-400 ohm resistor

R 9-24.000 ohm resistor

R10-20,000 ohm potentiometer

R21 2 000 ohm resistor

R12 153 ohm filament resistor thravy duty -Filter choke, 20 beney, 200 ohm

-Field of d namic speaker 3,000 ohrus

Short wave radio frequency choke

bet of five four prong short wave coils on ribbed forms

-Set of five us prope coll forms

-Midget dynamic speaker 3,000 ohm field

-Toggle switch Plug and cord

One four-proof socket, one five-prone socket five six-prong sockets, one chamis, two tube shields and bases, small knobs and escutcheon plates, small cabinet (optional), connecting wire, solder, etc.



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HUNTING YOUR CAR'S CASTER AND CAMBER

(Continued from page 64)

wheel has cumber, the distance at the top should be less than the hottom distance

Tor-in can be measured with a tape measure and a large pair of inside talipers made from a couple of lengths of lathing. You have to measure the distances between he made edges of the re or rim at the front and at the rear

IF THE car is an old model, two long laths, pointed at the ends and fastened together one on top of the other with four or five heavy rubber bands will do to space off the measurements. Of course, on new tark you'll have to add arms at the ends to get around the motor two

As for caster, you can use an adjustable spirit level to check that. The caster angle generally is obtained by the twist of the axle. So by placing the spurit level crosswise on the axle, first at one end and then at the other, and adjusting it, you can measure tach angle

Suppose some of these adjustments are wrone interropted Bill, "how do you make them right at

We'll it the caster, for example, in wroter, it generally means that the axie has been bent in an accident Naturally the only way to tex it is to bend it back."

Do you have to heat it?" asked Bill

That - he sac thoug you shouldn't do," derlates (sqs posits e). Heat would sport the or gina heat is atment that a responsible for the a tength. If you have to bend it do. it with he metal was It's a tough Job though and I wouldn't advise trying it unlesyou have experience and the right took. It roune, if the raster is out only a little, you can correct it by loosening the spring said dies and driving wedge-shaped shims in between the spring and the spring seat. That with the life aske

Lamber can be changed by bending the portion of the axle between the aprings and the wheels. As or too in that's the easiest to attend All you've got to do in lengthen or shorten the front aste tie rid

As him lanced & was importing each of the frost wheels on his ar. Hel what makes you think my trouble is unequalcaster?" he inquired at last

"I'm just like a doctor," chuckled Gu-I diagnose from symptoms. You complain of hard steering to the left and a tendency to pull to the right if you don't keep your hands on the wheel. My diagnoses from these symptoms is that each wheel has a different easter angle. The car turns to the right, that means that the right-hand wheel has less guster than the left

"It's the same with cumber, only you have to look in a different place for the symptoms. If you have too much earnber, | the outer edges of your tires will wear faster. than the rest of your tread."

WHAT are we mone to do about my impatients. There's no sense checking the caster of I can't have

"Well," drawled Gus, "I'd suggest that you check all three adjustments just for the practice. You can learn a beap about your car that way Then, when you find out just how much the caster is out, perhaps we can fix at with wedges

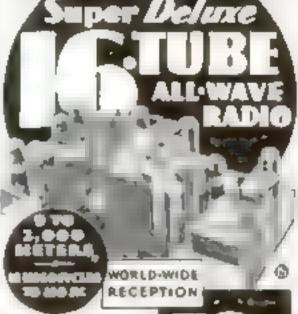
"And, by the way, before you do any cherking be sure that the cur is absolutely level and that the tires are properly pumped."

With that, Gus turned and ambled to ward the house. As he reached the front steps, he glanced back and grinned. Bill was hard at work, and Gus knew that doing was the best way of learning, and besides—now he could get back to that morning paper.









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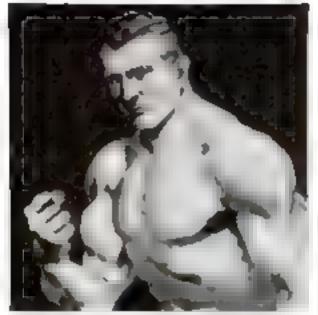
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NEW ENERGY TESTS SHOW OUR LOSS AT WORK AND PLAY

(Continued from page 3).

muscle is allowed to rest, the reverse takes place, 370 calories of heat disappearing as each gram of factic acid is reconverted into glycogen. In experiments on a frog's muscle. using a thermometer capable of noting changes as sexall as a hundred thousandth of a degree Centigrade, Dr. Hill discovered that for every twitch of the muscle the temperature of the fibers rose about three one thousandths of a degree

If you sprint 100 yards as fast as you can, your muscles will produce about an ounce of lactic acid. You feel tired in proportion to the amount of this acid to your system, for lettle unid and faturus are synonymous. In the blood of tired athletes, Dr. Hill found therty-five times as much of this lategor chemical as he did in the veins of a

rested mun.

A CURIOUS fact in this connection is that we recover in our legs from exercise taken in our orms? That is, the muscles all over the body are busy turning factic acid back late glycogen when one part of our body is exerrised. If this were not so, your arm muscles would become tired out in using a hammer or your leg muscles in peddling a bicycle long before they do, Incidentally, the muscles of marm be socied animals are capable of twice as much work per unit of mass at there of risk broaded animals. A man's musthe for instance or rem two to ten tubes as strong per unit of mass as a frog s

Because sugar is quickest transformed into glycogen, athletes are now being given this concentrated form of energy before important contests. It is usually most effective when eaten from a half to three quarters of an hour before the muscles are called anto action. This gives time for the chemical engines to transform it and store it up for use

At Yale University, Dr. Yardell Hender son has found that exhausted runners at the end of a race have used up practically all the sugar in the blood. They often show the wine symptoms as are produced by an overdose of Insulin, the sugar-reducing chemical injected into the blood in the treatment of diabetes, While sugar is not the only fuel of muscular energy, it is the quickest starting, the most maily transformed into glycogen Other foods rich in muscle fuel are bread, beans, commeal, hominy, honey Foods aiding the oxygen-carrying power of the blood by adding from are exes, spinach, figs, lean

beef, natmeal, and prunes

In making use of this food-fuel, our muscles form one of the most efficient machines to the world. A modern steam engine is between filteen and twenty percent efficient That is, it returns productive mechanical enemy equivalent to about fifteen or twenty calories for every hundred calories of fuel burned in its boiler. Gasoline engines have an efficiency of twenty to twenty-five percent while Dresel eurones run as bush as thirtyfive percent. But the trained muscles of the athirte top them all, exceeding forty percent Edison once estimated that the horse is only two percent efficient, requiring annually the product of five acres to keep it running

SPRINTER studied by Prof. Wallace O. A Fenn, of the University of Rochester Y., developed six horsepower during short speints and another examined by Dr. Hill, in England, reached eight and a ball borsepower in covering the hundred yard dash in record time. Most of this power is required to over come internal resistance to the swittene of arms and legs. Stopping also consumes energy. One test showed a track athlete uses as much energy in slopping as he would in

running an additional five yards at the very

top of his speed

Such high output of muscle power is confined to short bursts of effort however. The average laborer during an eight-hour day develops less than one tenth horsepower

SOME years ago, a United States Army officer, Capt. Brock Putnam, hid claim to the world's golf endurance record with a mark of 252 holes played in a single day Later, Dr P \ Karpovich made tests and found that a player walking over a fairly level 6,000-yard golf course uses up as much energy as he would in climbing to the top of the Empire State Building five times.

While the buman muscle is a highly efficient producer of power, a 2,000-poundcapacity dynamometer recently showed that the muscle of an ape, weight for weight, is three or four times stronger One female thimpazzee in an eastern zoo exerted a 1,260pound pull using both hands and a male chimpaness, pulling with one hand from an awkward position, registered 847 pounds. This proved to be more than four times the pull busky football linemen could exert . Turning to the lasect world, you find bewildering records of strength and speed

One scientist used a stop watch to time a black carpenter ant climbing the side of a stump. Carrying a dead spider twice as big as itself, the insect mounted vertically two feet in less than two seconds. As it measured only a quarter of an inch in length, it was traveling more than forty-right times its length a second. A 200-mile-an-hour racing automobile would cover only half as many times its length in the same time.

An even swifter insect is the sorder which weaves (unnel-shaped webs in meadows and weed-late. In proportion to its size, it is probably the fastest thing on seps in one instance, it was timed crowing a sevel table, covering more than a hundred times Its length a second. The observer calculated that a locomotive traveling at proportional speed would go four times as fast as the speed of sound and would cross the country from New York to Los Angeles in about one hour!

*HE strong men of the insect world are the beetles. Weight for weight, they are undoubtedly the strongest things alive. By piling tiny bags of fine shot, weighing from an eighth of an ounce up, on the backs of dung beeties, one experimenter made some amazing discoveries. A beetle which weighed only four and two-tenths grains was able to walk off with a load of eight and a fourth ounces taled on its back. This is more than 850 Limes its weight!

Another beetle weightnit ain grains lifted eleven and a half ounces. If a 150-pound man had proportional strength, he could pile twenty-five acven-passenger, (wo-and-a-ha)[ton limousines on top of each other and walk

off with the load on his back

However, in comparison with most living things, the muscles of man rank high as they are far more efficient than those of a majority of other animals. Mecently, scientuts have learned many things about how these chemical engines function and why they tire, but there are still a host of problems.

Why does brain work tire us? Why does a vegetable diet lower the amount of energy needed to run the body? How does a message from the brain convert glycogen into lactic acid? Why is the muscle of an age more efficient than the muscle of a man?

In an effort to grase these and other question marks, scientists in various parts of the world are shaping new experiments.

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HOW NIGHTHAWK TRUCKS MOVE THE NATION'S GOODS

(Centimued from page 19)

lowers, and out into the open country A cold mist in closing in. Telephone wares, white siles, and mailboxes with drooping flags are covered with mosture and have a silvery sheen in the beams of our headwights

FROM our seats, high in the cab, the Sights of approaching cars access to pass under us. By eleven o'clock, we have traveled nearly lorty miles over hilly country. At Runk's Road, Sleepy throttles down and rases over to the curb across from an electric ugn "WAN'S DINER It is our first stop to "coffee up."

Inside, "Red," the water, is carving thick slices from a boiled haza and kuld on with a row of truck drivers perched on stools at the counter. Over the coffee percolator is the cheerful greeting. "USE LESS SUGAR AND STIR LIKE THE DEVIL. WE DON'T

MIND THE NOISE

White we gulp down sundwiches and but coffee, Sleepy gathers the news of the road from the other drivers, Curley, Butch, Skip py, Herb, and Foggy. There are reports of speediraps, detours and "weighing its" locheck on the legal limit of 17,000 pounds for trucks and 16,000 pounds for trailers in Penmylvania, the police turry jack scalein cars, watch trucks labor up strep proceand picking out the overloaded mactiones weigh them in

When we leave Win's Diner the log has thickened. Sleepy snaps out the dashlight to see better A pale greenish glow enters the cab windows, coming from the high clear ance lights running along the top of the truck, eleven feet, two inches above the ground. Thurty Five, Sleepy explains, is a good for marking. Its bradlights are set low-Cluminating the concrete Asphalt bring black, is the worst kind of a bighway for for driving

A long, gray hus flushes past and disappears in the mist. Suddenly, high in the sky ahead of us, we see two don, close set lights dropping steadily toward the ground to though in a descending balloun. They bright en and out of the mist comes a car which has just descended the invisible road down the long Gap hill, highest point on the high-

On this forty-five percent incline, the truck foses headway rapidly. Sleepy shifts nears five times on the way up. Thirty-Five but right speeds forward and two in reverse.

Now watch her lay both her ears and dig in!" he says as he shifts the last time Slowly, the thundering engage drags the tracenton load up the last hundred yards of the

hill and over "the peak

On the other side, the for it even worse It is billowing up the slope like rolls of cotton batting Steepy knows every inch of the road and plunges down the hill for the long toboggan to the bottom. He has figused out what to do in every possible emergency. If the brakes should fail on a long hill, he would run the truck to the side of the road and, if possible, slide it along an embeakment until it stopped in pasw, if the machine started to abde backward downhit he would cut the front wheels at right angles to the road, the added resistance slopping the slide before it could gain mumen-

O'CE, on Sleighmaker Hill, beyond the Gap, he list his trailer. There was a jump, a jerk and the truck stopped in its tracks nearly throwang han through the wind sheld. An automatic mechanism sets the brakes of both truck and trailer when the

our and electric connections break apart. Another time, Sleepy was struggling to get over the Gap when he noticed in his rear view instruct a red patch coming and going on the wet pavement behind him. His brakes were on fire. The emergency lever had worked back a notch and the friction had started the fire. He leaped out and amothered the blaze with sand.

MIDNIGHT has struck before we sight the blue whirling search beam and the red boundary lights of the emergency landare tield near Contaville Cars are thinning out on the roads. On the downgrade, we meet a slove truck climbing the hill with the head behts of three impatient passenger machines peering like eyes from around the rear. Then miles go by without a car in aight

It is the hour of the trucks. We pass a big machine leaded with logs, another carry and senfood, a third packed with livestock More than 12,000,000 head of livestock a trac new go to market by motor truck

Beyond Contesvisie, we strike the long Malvern Holl, a lonely incline flanked by woods and ramshackle dwellings. A few years and one the alk tracks of the hork fleet w climbing this hill when a coacster contangers ones the researches duch. Fa long they pulled alongoide and fired shots pointolank into the bull-tproof aloss of the window, then sped away be-

Not far from the Newark Airport, Sleepy encountered a gong of high-speed thiever in an open highway early last year Twice, he reason! New York with the tarpaulin over his truck slit from slide to side and packas a moving Later, police nabbed the gang They would drive their speedy machine alongside a truck on the right, or blood side One of their members would scram se aboard slit the tarpaulin, tost off the parkages and then transfer back to the car which would drop behind and pick up the loot

By two A. M., we are running through small towns on the outskirts of Philadelphia The tag is siting. At Wayne, we pass Thirtyhis the two of our machine, going west with Herman Klausen at the wheel. The following might, when they meet sgain near the same spot, Thirty-Six will be going east Thirty Five heading west. Each driver maker three cound trips a week

Wayne, Sleepy says, has the most alert police along the line. They are always on their toes. They not unly know all the trucks but how each driver handles an machine A few months ago, this knowledge played an important start in capturing three stickup men preying on truckmen along the Lancoln

\$, hwa Ten miles west of the city, they himcked a truck, left the driver fied up in a ditch and beaded for Phnadelphia They made the mutake of going through Wayne. An alert traffic officer watched the truck go by noticed it was being handled in a marner different from usual, investigated, and nabbed the crooks red handed

BREAD trucks are starting their runs and miskings with lanterns are taking to their routes, as we pull into Ph ladelphia Because the traffic liebts go off at one A. M., the truck fleet tries to strike this largest city along the route after that hour

If you think it doesn't take any brains to drive a truck, rade with Sleepy Ulrich through a hig city. It is almost uncanny the way be sets but (Continued on page 119)

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HOW NIGHTHAWK TRUCKS MOVE NATION'S GOODS

(Continued from sage 128)

pace, speeding up or slowing down blocks away, to hit the traffic lights just as they go preca. He knows every one of the seventyfive lights between York and Manhattan and the length of time each stays on Changing genra and starting up is far more difficult with a fifteen-ton load than with an open roadster. So truck drivers strive to maintain an even pace throughout a trip.

THE worst night in the week for the highway express is Sunday. Then the roads are full of "Sunday drivers," old people returning from church, farmers visiting relatives, motorists who do little driving doring the week. They drive slowly and carefully, so slowly they delay traffic, increase the amount of passing on the road, and consequently the number of accidents. Saturday night the traffic is beavier, but there are more young people driving. They go fast and keep from under foot-

At a Philadelphia service station, we make a quick stop for gas. Seventy-five gailons is burned up by the big engine on its oneway trip. Sleepy is out examining the lights. testing the drive chains, kicking the tires. Each of these huge doughnuts of rubber weight in the neighborhood of 300 pounds.

It is three-thirty when we cross the Delaware and rut to the curb in front of the Pine Tree Diner, Sleepy shifts Eccase plates. We have crossed the line and are in New Jersey.

This four-lane highway is probably the most heavily traveled truck route in the country. It is the main setery into Manhattan from the south and west. As we plow steadily northward, we pass an increasing number of machines—gasoline trucks, bread trucks, meat trucks, produce trucks, flower trucks, white trailers filled with milk, red machines with waving flass and "HIGH EX-PLOSIVES" painted on the sides. They are all heading for New York. Thanksgiving turkeys, Christmas toys, New Year's calendars, Easter flowers, Fourth of July fire-crackers, all travel this ribbon of concrete to supply the needs of America's largest city.

Our machine is like one corpuscle in a vast system of circulation streaming along arteries of concrete to keep the city slive. As we rush north, other machines are racing west down the coast of New England, south along the Hudson, sust from northern New Jersey and southern New York. In the morning people find milk on their doorsteps, ment at the butcher's, bread at the baker's, newspapers in place, all because a host of trucks have been busy during the night. It is no overstatement to say that modern civilization rides on trucks.

SLEEPY'S watch shows five forty-five when we dive into the open mouth of the Hoiland Tunnel. More than 2,000,000 trucks a year use this 9,000-foot tube under the Hudson-

At the other end, we emerge into bare, deserted streets, wind half a dozen blocks between dark warehouses and then back into the glare of the York terminal Sleepy cuts the switch. It is a few minutes after als A. M. We have pulled a fifteen-ton load approximately 700 miles over hills, bridges. tunnels and highways in nine hours

We climb stiffly from the cab. Sleepy delivers his tickets and then heads for his hatel room for eight bouts sleep before the western run that night. Already crews of loaders are shifting our cargo to fast deliv-

ery trucks, During the day, west-bound consignments will pour into the depot. Another twelve hours, and Thirty-Five will roll again-a link in a yast chain of modern, high speed highway transportation.



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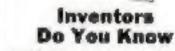
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New Mystery Rays Tap Atom's Power

(Continued from page 17)

detail in picture making. The hard ones are more penetrating and better adapted to the

treatment of deep-scated disease.

One recent development has been the perfection of apparatus which enables the operator to shoot tremendous amounts of soft rays through the body, getting pictures that give detail with exposures so short that the skin is not burned. In 1896, it took twenty minutes to X-ray a bone; in 1928 the exposure had been reduced to one second; today it is accomplished in 1/120th of a second. Enough electric current is forced through the tube in that fraction of a second to light 3,000 ordinary thirty-watt bulbs. In such high-powered tubes, the machine-gun fire of the streaming cathode particles may drill a hole clear through the tupgaten.

TO OVERCOME this difficulty, a Dutch inventor recently brought out a vacuum tube with a revolving target. An electromagnet travels around the outside of the glass of one neck of the tube. This keeps the metal disk within turning so the cathode particles his in different places. Several of those tubes are in use in hospitals in the United States.

One has been employed by Dr. I. Seth Hirsch, of New York City, to collect three-and-a-half-foot radiographs of the human trunk. He has classified the stomachs according to their positions in the body. Some, he found are almost horizontal, others almost vertical, some at one angle, others at another. Such pictures, he suggests, may prove almost as good as fingerprints in identifying the

To aid police in the work of identification, a Paris radiologist has just introduced an "X-ray fingerprint." He smears red lead lightly over the fingers before they are placed under the X-ray. The lead, collecting in the grooves between the ridges, outlines the whorks and markings of the fingerprints while the shape and size of the bones within the fingers give an added check upon the identity of the owner

of the hand.

Not only men but minerals are now identified by means of the X-ray. It has been found that when a beam of the rays is sent through a pinhole in a block of lead and then through a tiny crystal of some mineral, an array of sharp spots forming a perfect pattern is recorded on a photographic film. Each mineral has its own pattern by which it can be recognized.

Using this method of examination, not long ago, workers at the Natural History Museum, in London, England, discovered an entirely new mineral. It was found among minute crystals brought from the Transvaal in South Africa. The name Hragite has been given it in honor of Sir William Bragg, whose researches on the structure of crystals won him the

Nobel Prize

How far a ray can penetrate a solid depends upon its wave length. The shorter the wave length, the more easily it can slip between the atoms. Light rays are 10,000 times as long as X-rays and X-rays are from ten to twenty times as long as the gamma rays of radium. Consequently, for the most penetrating work, the radiologist employs radium.

AT THE Watertown Amenal, in Massachusetts, for instance, radium rays passed through twelve inches of solid steel and made perfect pictures through ten-inch castings. As a result, the U.S. Navy recently set uside \$50,000 to purchase four "radium torches" for examining castings in navy yards on the Atlantic and Pacific. One of these tiny capsules revealed flaws that explained why stern post castings on five out of eight new cruisers had cracked under the strain of high speed maneuvers. For X-rays, the limit of practication is about four inches of steel. At Boulder Dam, a 300,-000-volt, oil-immersed tube, with a lead-lined directing founel like the horn of an old-fashioned phonograph, is peering through penstock pipes made of four-inch sheet steel. In examining the weided scame on the twenty-five miles of pipe, it will take 150,000 pictures and use up 24,000,000 square inches of film.

BOTH X-rays and samma rays affect the sensitive emulsion of a photographic film in the same manner as light. The darkness of the film after it is developed depends upon the number of rays reaching it. Varying degrees of density in objects appear as varying shades of light and dark on the film. As birdshot would pepper the wood all around a steel object and thus leave its outline on a board, so the rays penetrate to the film all around a dense object, such as a key held in the hand, and reveal its size and shape.

At the recent American Congress of Radiology, held in Chicago, one of the ingenious devices on exhibit was an X-ray apparatus

Ultra-Short Waves Link Airports



THIS is one of the giant reflectors for the radio station operating on a wave length of only eight inches recently erected on an English air field. It will link the English airport with one in France.

which enables you to see with your eyes shut? It is the invention of Dr. A. H. Pirie of the Royal Victoria Hospital in Montreal, Canada. The closed eye is placed against a sort of metal eyecup at the end of a tube. Within the tube are letters of lead which are reflected on the retina of the closed eye so they can be seen. By replacing the letters with a circle of lead which is divided into four parts, the operator can discover the exact location of hits of metal or other foreign objects buried in the eye.

Another application for the new device is testing the nerves of affected eyes. Not long ago, for instance, a man, blinded by cataracts, came to the hospital for an operation. He was first tested on the Pirie apparatus. It revealed that the nerves of the eyes under the cataracts were dead. Thus, an expensive and use-less operation was avoided,

In X-ray and radium treatment, it is not the rays themselves that benefit; it is the trail of wreckage they leave behind in passing through the body. They collide with atoms, chip of electrons and send these electrified particles, released from their regular orbits, crashing back and forth like billiard balls, striking and injuring cells. The sick cancer cells are less able to withstand this battering by runaway electrons and are thus destroyed more easily than the normal, harder cells of the body. What actually happens to the destroyed cells, according to Dr. Raphael Isaacs of the University of Michigan, is that they are "speeded to old age" rather than being killed immediately. The electrons atimulate them, his researches have led him to conclude. until their life-cycle consumes but a small fraction of the time required for the normal cell to reach maturity, old age and death,

In this connection, sensational things have been accomplished recently by bathing plants with the invisible rays. At the Schenectady laboratory of the General Electric Company, for instance, a tiny grapefruit seedling, barely a month old, burst into flower after daily treatments with the X-ray. Ordinarily, these trees are five years old before their first flower

appears.

MUCH remains to be learned about the effect of X-rays and gameas rays upon the human body. Special precautions are always taken to protect the workers in laboratories and hospitals. Sheets of lead, mats made of lead and rubber, glass containing lead salts and resis compounds impregnated with lead, are used to shield the experts from the rays. At the Mercy Hospital, in Chicago, twenty-two tons of lead line the treatment room where the SCO-OGO-volt tube is used. The operator watches the patient through a device like a periscope and automatic switches cut off the current if any of the treatment room doors are accidentally left open.

The amount of radiation a patient can take depends upon his skin. The operator always stops before the skin is burned. Sometimes, when more of the rays are needed inside the body than the skin will stand, "cross-fire" technique is used. With the rest of the body protected by lead, the rays are sent through one spot. Then, with it protected, they are sent through another spot at a different angle. Thus, the total radiation received internally is greater than that received at any one point

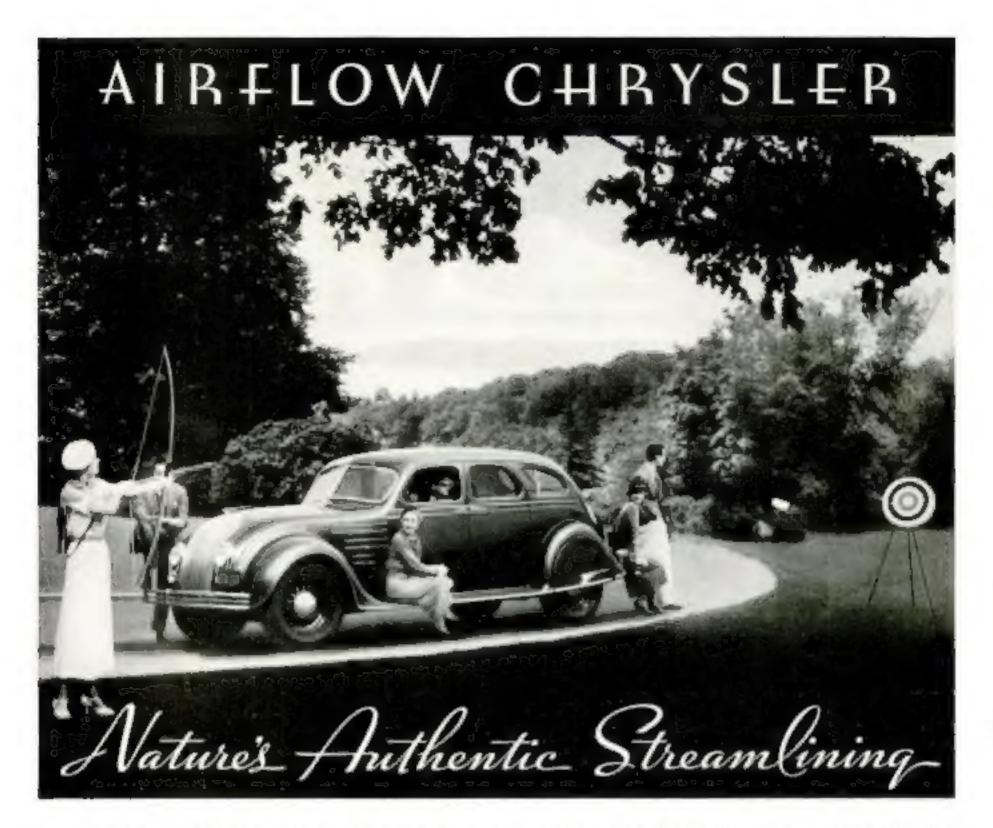
Probably the most unusual use of radium recently reported is an application made in Russia. Here it is southing out sparks and preventing area in a rubber factory!

on the surface.

The air in the factory is saturated with explosive vapors. Sparks of static electricity generated in the drying machinery were a constant menace. Even fine wire brushes failed to carry off all the electricity. So tiny capsules of radium were placed near the machines where the sparks were most dangerous. The radium rays ionize the air, filling it with electrified particles which allow the static charges to flow to the nearest metal part and thence to the ground.

The whole amazing history of radiology covers a period of less than forty years. New discoveries, new equipment, new technique add to the possibilities for the future.

Most spectacular of these advances is the creation of the neutron ray by the California scientists. Its weird ability to pentrate hard objects more easily than the light ones is expected to make it an important new tool in a field of sensational research,



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